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CLIMATE CHANGE LEGISLATION: CONSIDERATIONS FOR FUTURE JOBS

HEARING

BEFORE THE

COMMITTEE ON FINANCE
UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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CONTENTS

OPENING STATEMENTS

Page

Baucus, Hon. Max, a U.S. Senator from Montana, chairman, Committee on Finance 1
Grassley, Hon. Chuck, a U.S. Senator from Iowa 3

WITNESSES

Breehey, Abraham, director, legislative affairs, International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers, and Helpers, Department of Government Affairs, Fairfax, VA 4
Berrigan, Carol, director, industry infrastructure, Nuclear Energy Institute, Washington, DC 6
Green, Dr. Kenneth P., resident scholar, American Enterprise Institute for Public Policy Research, Washington, DC 9
Thorning, Dr. Margo, senior vice president and chief economist, American Council for Capital Formation, Washington, DC 10
Ton-Quinlivan, Van, director, workforce development and strategic programs, Pacific Gas and Electric Company, San Francisco, CA 12

ALPHABETICAL LISTING AND APPENDIX MATERIAL

Baucus, Hon. Max:
  Opening statement 1
  Prepared statement 35
Berrigan, Carol:
  Testimony 6
  Prepared statement 37
  Responses to questions from committee members, with attachments 44
Breehey, Abraham:
  Testimony 4
  Prepared statement with attachment 69
  Responses to questions from committee members 96
Grassley, Hon. Chuck:
  Opening statement 3
  Prepared statement 103
Green, Dr. Kenneth P.:
  Testimony 9
  Prepared statement with attachments 105
  Responses to questions from committee members 142
Hatch, Hon. Orrin G.:
  Prepared statement of Americans for Tax Reform 152
Kerry, Hon. John F.:
  "Falling Behind on Green Tech," *Washington Post* article by John Doerr and Jeff Immelt, August 3, 2009 157
Thorning, Dr. Margo:
  Testimony 10
  Prepared statement 159
  Responses to questions from committee members 169
Ton-Quinlivan, Van:
  Testimony 12
  Prepared statement 183
  Responses to questions from committee members 191

Page

COMMUNICATIONS

American Petroleum Institute 197
Association of American Universities and Association of Public and Land-grant Universities 200
Kammen, Daniel M. 203

CLIMATE CHANGE LEGISLATION: CONSIDERATIONS FOR FUTURE JOBS

TUESDAY, NOVEMBER 10, 2009

U.S. SENATE,
COMMITTEE ON FINANCE,
Washington, DC.

The hearing was convened, pursuant to notice, at 10:15 a.m., in room SD–215, Dirksen Senate Office Building, Hon. Max Baucus (chairman of the committee) presiding.

Present: Senators Kerry, Stabenow, Cantwell, Carper, Grassley, Hatch, and Roberts.

Also present: Democratic Staff: Bill Dauster, Deputy Staff Director and General Counsel; Thomas Reeder, Senior Benefits Counsel; Cathy Koch, Chief Tax Counsel; Pat Bousliman, Natural Resource Advisor; and Ryan Abraham, Professional Staff. Republican Staff: James Lyons, Tax Counsel.

OPENING STATEMENT OF HON. MAX BAUCUS, A U.S. SENATOR FROM MONTANA, CHAIRMAN, COMMITTEE ON FINANCE

The CHAIRMAN. The hearing will come to order.

In 1971, the noted economist and Harvard dean Edward Mason said: "There seems to be no reason to believe . . . that the employment-creating effects of restoring the environment will be any less than those involved in polluting the environment." It seems that the debate over jobs and the environment has been around about as long as we have had either jobs or an environment.

Today, we will consider whether climate legislation will create jobs in the energy sector. We will examine further this committee's role in climate legislation. And we will discuss what we can do to both create jobs and to ease the transition to an economy that accounts for the cost of carbon dioxide.

I am committed to passing meaningful, balanced climate change legislation. I am committed to legislation that will protect our land and those whose livelihood depends on it. I want our children and grandchildren to be able to enjoy the outdoors the way we can today. So I am going to work to pass climate change legislation that is both meaningful and can muster enough votes to become law.

Today, we will hear predictions—some optimistic, some otherwise—about the effects that climate legislation will have on American jobs and the American economy. We need to consider these predictions, but we also need to consider the consequences of failing to act.

We can already see some of these consequences in my home State of Montana. We can see the consequences in forests near my hometown of Helena, destroyed by pine beetles that thrive in warmer temperatures. We can see the consequences in sustained drought and more frequent wildfires, and hotter wildfires, I might add. We can see the consequences in decreased snowpack and lower stream flows, reducing water for irrigated agriculture and starving out our blue-ribbon trout streams of cold water—which I might add are a huge tourist attraction for our State's economy. These are serious consequences, and I believe that we can mitigate their effects in a way that does not harm the economy.

History is instructive. As a senior Senator on the Environment and Public Works Committee, I wrote much of the bill that became known as the Clean Air Act Amendments of 1990. That legislation established a cap-and-trade system to curb sulfur dioxide emissions and nitric oxides, as well. It helped to combat acid rain.

During the debate on that bill, several industry studies made dire predictions about the effects of the legislation on the economy. Even studies from the Environmental Protection Agency estimated the annual costs at between $2.7 and $4 billion a year. And, during that debate, there were also dire predictions about job losses. In 1990, the EPA predicted that between 13,000 and 16,000 coal mining jobs would be lost as a result of the Acid Rain Program.

But a decade later, an EPA analysis determined that the cost of cutting emissions was far lower than they had expected. Reaching the sulfur dioxide goals set by the 1990 Amendments cost an estimated $1 to $2 billon a year, less than half the original estimate.

EPA found that job loss was about one-fourth of what was predicted, and about 95 percent of the job loss that did occur was due to productivity gains in the industry. Very few jobs were lost due to the Acid Rain Program itself.

Let me be clear. We should work to minimize any job loss, but we should recognize that, in the case of acid rain, the negative consequences were far less than projected. We should keep this in mind when similar claims are made about the effects of legislation to address climate change. And we should recognize that the Bush administration noted how cost-effective the Acid Rain Program was. The Bush administration found that its benefits exceeded its costs by more than 40-to-1.

To be fair, the scope of climate change legislation is far broader than acid rain. And while we must always be mindful of the cost of legislation—that is particularly true in today's economy—our unemployment rate remains far too high. And it is estimated to stay high for a good time yet, not come down soon. And we must be diligent to create jobs, including in the energy sector. Again, we can point to some successes.

In recent years, Congress has extended and modified the tax credit for production of power from renewable resources, such as wind and biomass. With that credit, wind turbine and turbine component manufacturers announced, added, or expanded more than 70 facilities in the United States in 2007 and 2008. These facilities, when fully online, will represent 13,000 new direct jobs.

I am also very interested in a new incentive that we wrote earlier this year, a 30-percent credit for advanced energy manufacturing. We passed this credit to spur domestic production of clean energy development. I will be keeping a close eye on implementation of this credit, both in terms of energy independence and for creating jobs.

I look forward to hearing our witnesses' views. I look forward to further consideration of these issues in the Finance Committee, and I very much look forward to our efforts to protect both jobs and our environment.

I will be asking some questions. Some of them will be along the lines of a devil's advocate, pressing witnesses to see what is up, what is real, what is not.

I will now turn to Senator Grassley.

OPENING STATEMENT OF HON. CHUCK GRASSLEY, A U.S. SENATOR FROM IOWA

Senator GRASSLEY. Thank you, Mr. Chairman.

It is the responsibility of Congress to weigh the costs and benefits of every policy decision it makes, and the bigger the issue, the more important it becomes.

The Environment and Public Works Committee is the place for a detailed examination of the purported environmental benefits of any climate change proposal, and that is an important part of the equation. This committee's expertise is in the costs and economic impacts of new taxes. It, therefore, has the relevant expertise to evaluate the costs associated with climate change legislation.

Today's hearing, about the impact of climate change on jobs, builds on lessons this committee has learned from past hearings. Last year, then-Congressional Budget Office Director Peter Orszag testified that, under a cap-and-trade system, prices for energy would necessarily increase. "Skyrocket" is the term that President Obama has used about price increases. Dr. Orszag explained, "Such price increases would stem from the restriction on emissions and would occur regardless of whether the government sold emission allowances or gave them away. Indeed, the price increases would be essential to the success of a cap-and-trade program. . . ."

Both he and Robert Greenstein of the Center for Budget and Policy Priorities also testified that the impact of those price increases would fall most severely on the lowest-income Americans.

Some have tried to claim that cap and trade would somehow make enough money through auctioning allowances to cover increased costs to American families, but this ignores the fact that this money will be taken from the American people in the first place.

The current Director of CBO, Doug Elmendorf, addressed this issue when he testified before the committee in May of this year. In response to written questions, he made clear that "the allowances that are created under a cap-and-trade program do not add wealth to the economy. Rather, they are simultaneously a cost and a source of income." He also went on to make it very clear that the value of allowances would ". . . inevitably fall short of the total economic effects of the policy. . . ." In other words, there is no free lunch with this issue.

At the same hearing, Dr. Elmendorf testified that "by channeling productive resources toward reducing (the risk of damages from climate change) rather than toward producing goods and services that are measured in gross domestic product, such policies would be likely to reduce GDP relative to what otherwise would occur.”

In testimony just last month before the Energy and Natural Resources Committee, he confirmed that economic productivity and jobs would be lost as a result of the House-passed cap-and-trade bill. Despite this, the more stringent Senate version of this legislation is incredibly entitled the “Clean Energy Jobs and American Power Act.”

Like any government regulation, there will inevitably be winners and losers, and we will be hearing about that in today’s hearing. That is why this hearing is so very important. However, an honest cost-benefit assessment requires that we first stop trying to sell this policy as if it will have no cost for Americans, and accept the basic economic principle that there is no such thing as a free lunch.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Grassley.

Now, I would like to introduce our panel. The first witness is Abraham Breehey, who is the director of legislative affairs for the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers, and Helpers.

Next is Carol Berrigan, director of industry infrastructure at the Nuclear Energy Institute.

Third is Dr. Kenneth Green, resident scholar at the American Enterprise Institute for Public Policy Research.

Then, Dr. Margo Thorning, senior vice president and chief economist with the American Council for Capital Formation.

And, finally, we have Van Ton-Quinlivan. Is that right?

Ms. TON-QUINLIVAN. Yes, sir.

The CHAIRMAN. Good.

Director of workforce development and strategic programs, Pacific Gas and Electric Company.

All right. Mr. Breehey, you are first.

STATEMENT OF ABRAHAM BREEHEY, DIRECTOR, LEGISLATIVE AFFAIRS, INTERNATIONAL BROTHERHOOD OF BOILERMAKERS, IRON SHIPBUILDERS, BLACKSMITHS, FORGERS, AND HELPERS, DEPARTMENT OF GOVERNMENT AFFAIRS, FAIRFAX, VA

Mr. BREEHEY. Chairman Baucus, Senator Grassley, and members of the committee, my name is Abraham Breehey, and I am the director of legislative affairs for the International Brotherhood of Boilermakers. On behalf of the members of my union, thank you very much for the opportunity to testify here today.

The members of the Boilermakers Union will be among those workers on the front lines of our Nation’s transition to a clean energy, low-carbon economy. We recognize that it will not be easy, but it is essential that the United States not wait to begin the important work of reducing emissions that cause climate change.

If Congress moves forward with a comprehensive cap-and-trade program, the demand for climate solutions will create job opportunities across the economy. We can put American ingenuity and skills to work reducing emissions and turn the jobs union members do every day into the environmental solutions our Nation needs.

The lack of a comprehensive policy on global warming and the uncertainty associated with the future regulation of greenhouse gases is delaying the creation of job opportunities. Waiting to provide investors, regulated entities, and entrepreneurs the market signals that will reward innovation only gives America's competitors a head start in the clean energy race.

The Senate must demonstrate bipartisan leadership and develop the kind of policies that will provide certainty, control costs, and encourage job-creating investments. We must not miss an opportunity to make the United States the leader in advanced coal technology development, an undertaking that is essential to meeting any significant global effort to reduce emissions.

We greatly prefer effective, balanced legislation to regulation of greenhouse gases under the Clean Air Act. Legislation would more effectively balance regional, environmental, and economic concerns, while providing the necessary incentives for technology deployment that will create jobs.

The development and deployment of carbon capture and storage technology at power plants and industrial facilities is among the technological breakthroughs that could reduce our Nation's carbon footprint and create job opportunities for American workers. The level of investment, both Federal and private, necessary to ensure that widespread commercialization of CCS happens is highly unlikely in the absence of comprehensive clean energy legislation.

We appreciate Chairman Baucus, Senator Carper, and the other Senators involved, for their work in the development of the provisions of S. 1733, designed to encourage early and widespread deployment of CCS at coal plants. The construction of coal-based generation facilities and CCS technology is tremendously labor-intensive. The National Commission on Energy Policy recently issued a report from its Task Force on America's Future Energy Jobs.

This task force included representatives of organized labor, industry, and the academic community. The task force relied, in part, on job data provided by Bechtel Power Corporation to estimate the labor needs associated with the construction of new, clean energy generation infrastructure. The estimates for alternative generation technologies indicate that coal-based CCS and nuclear power generation options have the highest job creation potential relative to other supply options, such as natural gas.

Based on Bechtel's analysis, the development and construction phase of deploying a normalized 1 gigawatt of power generated by an Integrated Gasification Combined Cycle coal plant equipped with CCS would employ over 2,700 salaried workers and an hourly workforce of over 8,000 skilled workers. CCS development and deployment represents tremendous employment opportunities for the members of my union and other workers in the building trades. Early deployment and bonus allowance programs for CCS, included in the comprehensive climate legislation, will be a tremendous driver for job creation in our economy.

However, good jobs will not necessarily be created by any climate legislation without the inclusion of fair, enforceable labor standards. The application of wage standards to the deployment of energy infrastructure will ensure that the benefits of Federal investment are extended not just to developers and businesses, but to the people whose skills are necessary to make this transition happen.

For example, under the Clean Energy Jobs and American Power Act of 2009, workers employed on projects assisted or incentivized through allowance allocations will be assured wage rates no less than those prevailing in their local community. Ensuring these high standards for both workers and contractors will be particularly important when applied to new, highly technical construction projects, such as CCS.

While comprehensive climate legislation that establishes a declining cap on carbon will lead to the creation of new employment opportunities, Congress must also act to mitigate adverse employment impacts. Climate policy must not undermine the competitiveness of U.S. manufacturers in the global marketplace. An adequate allocation of allowances to an output-based rebate program for energy-intensive trade-exposed industries will ensure that the migration of jobs and pollution to countries that fail to act does not undermine the goals of domestic action. It is also important that the Senate include a strong, yet fair, border measure to prevent so-called carbon leakage.

In addition, it was deeply disconcerting to learn, this week, that Federal clean energy investments made through the Recovery Act have been used for projects that generate jobs in China and not in the United States. As was widely reported, a Texas wind farm project that will rely exclusively on wind turbines manufactured in China has applied for financial assistance from the U.S. Department of Energy. It will be American workers and American taxpayers making the sacrifices to reduce emissions. It must also be American workers who benefit from the job creation opportunities these climate solutions create.

There are new opportunities for American workers, not just in the final construction jobs, but throughout the supply chains of clean energy technology.

I want to close just by reiterating the enormous potential we believe is available to put people to work building the climate solutions we need. This includes energy efficiency through building retrofits, CCS, and countless other innovations, but the work does not start until Congress provides the rules of the road and the right incentives. The time to act is now. We can make our economy more efficient, more energy independent and provide the low-carbon jobs we need for long-term, sustainable economic growth.

Again, I want to thank the committee for the important work you are doing and the opportunity to express our views.

The CHAIRMAN. Thank you, Mr. Breehey.

[The prepared statement of Mr. Breehey appears in the appendix.]

The CHAIRMAN. Ms. Berrigan?

STATEMENT OF CAROL BERRIGAN, DIRECTOR, INDUSTRY INFRASTRUCTURE, NUCLEAR ENERGY INSTITUTE, WASHINGTON, DC

Ms. BERRIGAN. Chairman Baucus, Ranking Member Grassley, and members of the committee, I appreciate this opportunity to express the nuclear industry's views on future jobs under climate legislation. I am Carol Berrigan, senior director of industry infrastructure at the Nuclear Energy Institute.

Let me begin by thanking members of this committee for your long-standing oversight of the Nation's fiscal affairs and for your support of legislation, like the production tax credit for new nuclear generation as passed in EPAct 2005, and the tax credit for manufacturing clean energy technologies afforded under the American Recovery and Reinvestment Act this year.

Both of these programs are important initial steps towards the financial incentives necessary to accelerate the deployment of nuclear energy generation and rebuild the Nation's manufacturing infrastructure.

Today, the 104 operating reactors in the United States produce one-fifth of America's electricity. U.S. utilities are preparing to build advanced-design nuclear power plants to meet our Nation's growing electricity demand. Currently, 13 applications for 22 reactors are under active review by the Nuclear Regulatory Commission. Over $4 billion has been spent on new plant development over the past few years, and the industry plans to invest approximately $8 billion in the next few years to be in a position to start construction of the first nuclear reactors in the 2011 to 2012 time frame.

Nuclear energy represents more than 72 percent of the Nation's emission-free generation portfolio, avoiding nearly 700 million metric tons of carbon dioxide per year. This is the equivalent of removing 133 million of the 136 million passenger cars from our roads.

As Congress and the administration consider climate legislation, mainstream analyses show that reducing carbon emissions will require a portfolio of technologies, and that nuclear energy must be part of that portfolio. Further, they indicate that the major expansion of nuclear generating capacity over the next 30 to 50 years is essential.

Nuclear energy can have a significant, positive impact on the workforce and manufacturing base that arises from current plants, new plants, and the supply chain. Each current nuclear unit in operation today directly employs 400 to 700 people. In addition to direct employment, the industry relies on numerous vendors and specialty contractors for additional expertise and services. Over 30 million man-hours are worked by supplemental craft labor each year.

In addition to payroll spending, nuclear companies procured over $14 billion in materials, fuel, and services from over 22,500 domestic suppliers last year. While only 31 States have nuclear power plants, nuclear procurement takes place in all 50 States, with an average of $277 million of procurement occurring per State. In several States, this procurement is in excess of $1 billion.

The resurgence of nuclear energy will lead to increasing demand for skilled labor at all levels. In addition to producing carbon-free electricity, construction of new nuclear power plants will create tens of thousands of jobs. According to a recent analysis by the National Commission on Energy Policy, the development of a nuclear power plant project will require 14,360 man-years per gigawatt installed.

A robust nuclear construction program will also significantly expand the U.S. manufacturing sector and the domestic nuclear supply chain. The nuclear supply chain represents a major opportunity for American manufacturers to expand capacity to meet the needs of a growing world nuclear-power market. Today, there are 53 nuclear power plants under construction around the world. In addition, there are 137 plants on order or planned, and 295 projects under consideration.

Thanks to the increasing world demand for new nuclear reactors, American companies have an unprecedented opportunity to expand the nuclear manufacturing base and open new international markets. In the process, nuclear suppliers can contribute substantially to job creation, economic development, and the reduction of greenhouse gas emissions. A program to expand nuclear energy, to meet U.S. climate change goals, will require a sustained partnership between Federal and State governments and the private sector.

Financing is the single largest challenge to accelerated deployment of new nuclear power plants. An effective, long-term financing platform is necessary to ensure deployment of clean energy technologies in the numbers required, and to accelerate the flow of private capital.

Federal tax stimulus is also an important element that would accelerate capital investment in new nuclear power plants. Tax incentives could also help refill the pipeline of highly trained personnel to build, operate, and maintain new plants, and restore America's ability to manufacture the components and other equipment that go into nuclear plants in the U.S. and abroad, thereby creating additional jobs.

To provide the level of financial stimulus necessary, we encourage you to create a permanent financing platform to provide loans, loan guarantees, and other credit support to clean energy technologies, including new nuclear power plants and new nuclear equipment manufacturing facilities; provide tax stimulus for investment in new nuclear power plants, new nuclear-related manufacturing and workforce development; and expand the existing production tax credit provided by the 2005 Energy Policy Act.

Mr. Chairman, in conclusion, the role of nuclear energy in achieving the Nation's climate goals is clearly established. The expansion of nuclear energy in the U.S. and globally provides significant opportunities for American workers and industry, increasing high-wage employment and significantly expanding our domestic manufacturing sector.

I encourage you and this committee to continue your legacy of leadership on these issues and promote legislation that would provide the necessary financial stimulus to realize these goals.

Thank you.

The CHAIRMAN. Thank you, Ms. Berrigan.

[The prepared statement of Ms. Berrigan appears in the appendix.]

The CHAIRMAN. Dr. Green?

STATEMENT OF DR. KENNETH P. GREEN, RESIDENT SCHOLAR, AMERICAN ENTERPRISE INSTITUTE FOR PUBLIC POLICY RESEARCH, WASHINGTON, DC

Dr. GREEN. Chairman Baucus, Senator Grassley, and members of the committee, thank you for inviting me to testify today on this timely and important topic.

I am Kenneth Green, a resident scholar at the American Enterprise Institute. I am an environmental scientist by training, a policy analyst by avocation, and an economist by exposure.

I have submitted for the record two AEI policy studies on the issues before us today, which are part of the research base underlying what I am about to say.

I have spent the last 15 years analyzing public policy at think tanks in both the United States and Canada, with an emphasis on air pollution, climate change, and energy policy. Specifically, I have studied market-based mechanisms for dealing with pollution problems of all sorts, and have studied cap and trade as it has made its appearance in conventional air pollution control, acid rain mitigation, and now, in greenhouse gas control.

What I can tell you, based on my research, is this: cap and trade, the core of greenhouse gas control legislation today, is an inappropriate policy tool for the control of greenhouse gases that will cause significant economic harm, will kill export jobs, and produce little or no environmental benefit.

Current legislation applies an emission-trading model to an unsuitable pollutant. For emission trading to work, you need readily available technology to capture emissions, or alternative sources of energy, that can let some people generate surplus emissions that can be sold to others. We heard that with SO_2; we do not have that with CO_2. With CO_2, as EPA acknowledges, we are dependent on offsets to control costs, and offsets are notoriously slippery. Even the economists who first developed the theory and practice of cap and trade have said that it is not a suitable mechanism for greenhouse gas control. Earth First agrees. And when you have that level of agreement from economists, Earth First, and people like myself at AEI, you are talking a serious consensus. Cap and trade has not worked in Europe, and it will not work here.

By design, and despite provisions that try to hide this from the public, the carbon control bills now circulating will increase energy prices. That is what they are for—slowing economic growth, killing jobs, and reducing competitiveness.

And this is a one-way street, since cap and trade does not only cap emissions, it caps economic growth. When GDP goes up, energy consumption does also, as do carbon permit prices, choking off continued growth. The tighter the emission cap, the tighter the economic straightjacket.

As energy prices rise and as American companies find themselves less competitive, businesses and jobs will flow to countries without greenhouse gas controls, and without stringent environmental controls of any kind, potentially allowing emissions to increase. The remedy to this, border tax adjustments, is only likely to cause a trade war, further damaging the U.S. economy. As increased energy costs raise the cost of U.S. goods and services, consumption will decline, causing still more job losses across the American economy.

Legislation now before Congress will cause regional and sectoral winners and losers, will unjustly redistribute and export wealth from industrial, coal-powered States into States with greater hydro, nuclear, and natural gas resources, and will send taxpayer dollars abroad to countries that are our economic competitors, and sometimes geo-political adversaries.

Perversely, low-carbon fuel standards might actually prohibit oil imports from our number-one foreign supplier, our neighbor to the north, Canada. Cap and trade creates a new, poorly understood financial instrument that can be used to leverage debt, potentially creating a massive carbon bubble that bursts once it becomes clear that we cannot afford to maintain the regime.

Finally, cap and trade, and all carbon control for that matter, puts a bounty on ecosystems. As carbon control favors biofuels, more ecosystems will be planted over, and farmland used to grow fuel instead of food. A recent article in *Science* observes that attempting to limit CO_2 concentrations to 450 parts-per-million—the currently stated goal of carbon controls—would cause bioenergy crops to expand, to displace virtually all of the world's natural forests and savannahs by 2065, and actually increase global greenhouse gas emissions.

As for the claim that the green energy provisions of current legislation will create green jobs that cannot be exported, this is simply not true. As I testified before another Senate committee, governments do not create jobs, they simply move them from one place to the other, inevitably, with less jobs on net. Economists have known this for over 150 years. Europe has seen much of its green industry exported, and the U.S. has already seen solar cell and windmill production being moved to China.

The only thing worse than no energy policy is bad energy policy, and that is what S. 1733 and approaches like it represent: bad energy policy wrapped up in misleading terminology that hides the true nature of the legislation.

Thank you for allowing me to speak to you today on this timely and important issue. I look forward to your questions.

The CHAIRMAN. Thank you, sir.

[The prepared statement of Dr. Green appears in the appendix.]

The CHAIRMAN. Dr. Thorning?

STATEMENT OF DR. MARGO THORNING, SENIOR VICE PRESIDENT AND CHIEF ECONOMIST, AMERICAN COUNCIL FOR CAPITAL FORMATION, WASHINGTON, DC

Dr. THORNING. Thank you, Chairman Baucus, Ranking Member Grassley, for allowing me to testify today on this very important issue. I am Margo Thorning, senior vice president and chief economist of the ACCF.

Having watched this debate in Congress for the past 15 years, I am reminded of a situation—I am a life-long horse lover—of trying to lead a horse over a cattle guard. You have large segments of the business community and the private sector concerned about moving forward on this type of legislation, just as the horse digs in his heels and will not be led through a cattle guard because he will break his legs; he knows that. So, I think it behooves us to look very carefully at what these policies might mean in terms of job growth and employment.

When policymakers are confronted with the decision about whose model is best, what numbers are right, I think you need to distinguish between macroeconomic models used to look at the costs of climate bills and input-output models. Most government agencies and private think tanks rely on macroeconomic models, because they are able to capture the dynamic impact of changes in energy prices: how they flow through the economy, how they impact production, and how they impact capital stock and employment. Input-output models, which some organizations use, are static models; they are not able to capture the dynamic impacts of changes in energy prices.

I would like to share with you, briefly, the results of a study that the ACCF and the National Association of Manufacturers sponsored, examining the impact of the Waxman-Markey bill. We used a macroeconomic model, the same model that the Department of Energy uses, the National Incident Management System (NIMS) model. Our study showed that for the U.S. as a whole, by 2030, the Waxman-Markey bill would reduce gross domestic product relative to the baseline forecast between 1.7 percent and 2.4 percent. Two-point-four percent GDP may not sound like much, but it is about $600 billion. That is about what we are paying Social Security recipients right now.

Job growth would be slowed. We did show that we would pick up new green jobs; certainly we will because of the provisions of the Waxman-Markey bill, but on balance we lose between 1.7 and 2.4 million jobs in the year 2030. Household income is about $1,200 less than it otherwise would be. Some of the input-output studies that are out there show job growth, but again, as the Center for American Progress study admits, they are not dynamic and they are not able to capture the impact of higher energy prices on the U.S. economy.

So, what are the positive steps that we could take to try to ensure job growth, as well as energy security, and also make an impact on the growth of greenhouse gas emissions? First, we should expand access to onshore and offshore reserves. We should also expand and make it easier to build nuclear generating capacity. Nuclear can certainly be a big part of the solution here.

We should also accelerate our research on carbon capture and storage so that we can burn our vast supplies of coal without negatively impacting job growth. We should continue to work with the Major Economies Initiative to try to promote best technologies abroad and accelerate the uptake of clean, less emitting technologies.

So, on balance, when I look at the impact of the Waxman-Markey bill or the Kerry-Boxer bill, I can see that most studies, including some from CBO, EIA, Charles Rivers, and others, and—as I mention in Table 2 in my testimony which summarizes those—the macroeconomic study shows significant costs. As EPA has testified and as the Obama administration has admitted, if the U.S. goes it alone and adopts these targets, the environmental benefits would be almost nil. By the end of this century, there will be virtually no difference in global greenhouse gas concentrations.

So, when we look at the costs of these bills, and we look at the benefits, it is pretty clear the costs outweigh the benefits, and we need to go forward, build a bridge that even the most skittish horse would be willing to cross, based on better technology, and accelerating working with developing economies.

Thank you.

The CHAIRMAN. Thank you very much, Dr. Thorning.

[The prepared statement of Dr. Thorning appears in the appendix.]

The CHAIRMAN. Next, Ms. Ton-Quinlivan?

STATEMENT OF VAN TON-QUINLIVAN, DIRECTOR, WORKFORCE DEVELOPMENT AND STRATEGIC PROGRAMS, PACIFIC GAS AND ELECTRIC COMPANY, SAN FRANCISCO, CA

Ms. TON-QUINLIVAN. Chairman Baucus, Ranking Member Grassley, and members of the committee, thank you for having me here today.

I am Van Ton-Quinlivan, director of workforce and development at Pacific Gas and Electric Company, California's largest utility.

As our sector looks ahead, we see an aging infrastructure, the advent of new technologies, and a workforce of approximately 400,000 people with an average age in the mid-40s and 50s. Over the next 5 years, 30 to 40 percent of the industry's workforce is eligible to retire.

Utilities provide a range of employment opportunities for workers with various skills and education levels. We are unique in that we are located in every community across the country, from large cities to small towns. The need for a reliable stream of workers for our sector would touch every State and region of the country.

At the same time, according to several studies, not only will our sector need to replace large segments of the existing workforce in the next 5 years, but we will also need to ensure that the workforce exists, able to fill new jobs that our industry creates, as well as jobs in sectors that support our industry.

According to a study conducted by the Brattle Group, our industry is poised to make approximately $2 trillion in capital expenditures over the next 10 to 20 years to meet future demand and replace our current infrastructure. Many of the recent actions taken by Congress have been helpful with regard to advancing the new energy infrastructure, but they have been temporary or time-limited.

For an industry that makes long-term capital decisions and deploys assets with long lead times, we need a clear, long-term national policy direction that builds off the strong foundation Congress has put in place through tax policies, loan guarantees, and other funding and policy initiatives. Doing so will further unlock more of this investment and send a signal to our industry regarding the types of expenditures we need to make, the workers we will need to hire, and the types of skills these workers will need to possess.

As opportunities become available, we are focused on having the right people, in the right place, with the right training, at the right time. The National Commission on Energy Policy's Task Force on America's Future Energy Jobs brought together diverse stakeholders to better understand and start to address this issue. The task force commissioned Bechtel Power to provide estimates of the workforce needed for the new energy economy.

Key insights from that report are: a decline in career and technical education has stressed the power sector's training capacity, a large percentage of the electric power sector's workforce is nearing retirement, and creating a low-carbon energy system will require more workers than the industry currently employs and a new set of skills.

The deployment of new assets will require new design, construction, operation, and maintenance skills and more workers than the industry currently employs. This is an important opportunity for job creation and economic growth. If too few individuals with necessary expertise are available, however, workforce bottlenecks could materialize and slow the industry's ability to take on workers.

It is the situation that our company is working to avoid. In 2008, building off successful training models, we launched the PG&E PowerPathway workforce development program. PowerPathway collaborates with the community college system and the Workforce Investment System to enlarge the candidate pool for our skilled craft positions. Program graduates have qualified at an unprecedented level on PG&E's pre-employment tests, and over 50 percent of graduates have been hired by us or by our contractors.

We are sharing 30 years' worth of energy efficiency experience with the community college system to help deliver on green jobs training and support the massive investment being made in energy efficiency, including weatherization on building retrofits. We are working with the California State University system to create certificate programs in the power engineering and Smart Grid arena.

When it is time to hire, employers go to where the talent exists. Policies need to focus on establishing a pipeline of skilled workers throughout the country. The NCEP task force made several recommendations with regard to these policies, which are included in my submitted testimony.

We appreciate the efforts Congress has made to date. I look forward to working with the Senate to craft a comprehensive energy and climate package with a focus on those provisions that can quickly transition workers into the new energy economy.

Thank you.

The CHAIRMAN. Thank you very much, all of you.

[The prepared statement of Ms. Ton-Quinlivan appears in the appendix.]

The CHAIRMAN. I am going to ask a question of you, Dr. Thorning, in respect to your job loss projections and projected cost allowance in future years. There are a lot of projections around, probably because this is very difficult for this new ground, new territory—and it is difficult.

Nevertheless, I did note—and I would just like your comments on it—that comparing your projections with those of EPA and EIA, for example, and CBO, say by the year 2030, your projected job loss is much higher than that of other projections, and, if I read your chart correctly, you have projected an allowance cost of between $48 and $61 per ton by 2020 that increases to between $123 and $159 per metric ton by 2030, which is much above that of others.

Now, much of one's conclusions are because of one's assumptions. If you could tell us what your assumptions are that led to that result. It is much different from the results of other projections.

Dr. THORNING. Thank you, Senator, for that question.

The assumptions that we used in our study are attached to the appendix. I apologize if that did not get to you last night, but I did send it, and it was inadvertently left off. But the reason the allowance costs are higher, as shown in Table 2, from our high-cost and low-cost case, is that we built in realistic assumptions about how quickly new technologies can be deployed.

We assumed in our low-cost case that 25 new nuclear plants would be up and running by the year 2030. Now, we have not built a nuclear plant since 1978, so to get 25 new plants, 25 gigawatts up in the next 18 years, we think is, between 2012 and 2030, pretty generous. Our high-cost case assumed 10 new nuclear plants in place by 2030.

In terms of carbon capture and storage for coal and natural gas, the low-cost case assumed 60 gigawatts, the high-cost case about 30, and renewables, a similar spread between how quickly we can deploy renewables, and all of those assumptions are attached to my testimony.

We tried our best to build in realistic assumptions about how much banking would be able to be put in place, how many offsets could actually be used. And, when we put in place what our consultants and experts from various industries thought were realistic assumptions, the allowance prices that are shown in Table 2 are what the NIMS model solved for.

I would like to note that EIA's case, which is also shown in my table—one of their cases where they limit international offsets, they limit how quickly new nuclear can be put in place—shows even higher allowance prices in 2030 than do our simulations.

So, I think it is all, as you point out, a question of what assumptions you use. Some of the EPA work assumes 150 new nuclear plants in place by 2050. We think that is four a year between now and over the next 4 decades. We think that may be unrealistic, too. So, it is very important for you to look at the assumptions behind an analysis. EIA's base case assumed, I think, more than 100 nuclear plants by 2030. We think that is not realistic to build four nuclear plants a year for the next 18 years.

The CHAIRMAN. As we look at these analyses, what assumptions do you think are the most relevant?

Dr. THORNING. I think the assumption about new technology, how quickly can we build nuclear, and how quickly can carbon capture and storage become commercial, because it is not commercial now.

The CHAIRMAN. Any kind of technology in particular? Are you talking about CCS? What are you talking about here?

Dr. THORNING. Well, CCS, exactly, and how quickly renewables can be cost-effective sources of energy, how construction costs change. And, of course, alternative energies we continue to hope will play a larger part, but right now, they are fairly expensive.

The CHAIRMAN. Are there assumptions that are particularly helpful to examine? If we are going to compare apples with apples, it is good to know what——

Dr. THORNING. Well, of course, when you are doing the basic modeling you need to be sure the growth rate assumptions and the baseline forecast are the same, and, in our case, our baseline forecast for growth is the same as what EIA used in 2009. So, you want to, as you properly point out, compare apples to apples, and also look hard at what the technology assumptions are because I think that is the driving force for what is going to be the cost of reducing U.S. greenhouse gas emissions.

The CHAIRMAN. My time is up. One quick question.

You are a bit of an outlier, based upon what I know. There might be many other projections out there I am unaware of. So, if some were to criticize your projections, what would those criticisms be? If someone had another point of view, what would the most legitimate criticism be?

Dr. THORNING. They might say that our choice of how much offsets is too constraining, but we base that on some of the work from GAO, pointing out the problems with documenting and using offsets. Some of the constraints in the Waxman-Markey bill may make it hard to use those offsets. People could criticize that.

Some people might say, well, renewable energy you have constrained, but based on the difficulties of integrating renewable energy into the grid and the difficulty in siting transmission lines, we think they are realistic.

The CHAIRMAN. My time is up. Thank you very much.

Senator Grassley?

Senator GRASSLEY. You can call on Senator Roberts.

The CHAIRMAN. All right. Senator Roberts has asked if he could say a few words. He has a very imminent appointment.

Senator ROBERTS. I am not sure that “few words” and “Roberts” is not an oxymoron. [Laughter.]

I apologize to my colleagues. I have an 11:15 appointment that I simply have to make, and so, I beg your indulgence. And thank you, Mr. Chairman. Thank you so much for holding this hearing. It is very timely.

Dr. Thorning, you talked about the macro impact. I am going to concentrate on the micro, which is my State of Kansas and what it is all about. About 7 percent of the Kansas workforce is currently unemployed. We are very fortunate in that respect when we are in a 10-percent arena, an unemployment rodeo that we are going through that we would just as soon not go through. But we really do need an honest and open debate of cap-and-tax proposals, like the two bills we are discussing. So, thank you to the ranking member and of the chairman, again.

I want to emphasize that Kansans have long supported renewable energy. That is not the question. We continue to make investments in these industries. Siemens will soon locate a wind turbine manufacturing facility in Hutchinson, KS. We have similar investments all over our State.

Abengoa is locating a cellulosic ethanol biorefinery in a place called Hugoton, KS. These decisions are based on a mix of market conditions, however, and consumer demand, not because of cap-

and-trade legislation in the Congress. Cap-and-trade proposals, which try to ration domestic energy production, would lead to higher unemployment rates and a net loss for our State, both in jobs and also economic input.

Let me give you a few examples, and really what we try to do, and I know many members of this committee do, is when you get a huge bill like healthcare, or like energy, or like whatever we are dealing with, we really appreciate the testimony of the panel, and we take it to heart. But, what I do is go right out to Kansas and I ask the people involved, is this going to work, tell me if it is going to work, will it be a benefit to you, or do you want it, or perhaps it will not.

We rank nine, number nine, with oil and number eight in gas production, and together oil and gas contribute $350 million in State revenues—that is vitally needed in the situation we are in today—each and every year, and employ about 28,000 men and women.

In each of the last 2 years, the Kansas oil and gas industry invested over $1 billion—$1 billion—into our rural communities, our small communities. You would be hard-pressed to find an industry other than traditional fossil fuels and agriculture that is able to do this.

Additionally, three mid-sized communities, by Kansas standards, are home of a refining industry, small, but struggling and very industrious. In McPherson, with a population of 13,500, a small farmer-owned cooperative refinery employs 640 hardworking men and women. I said this was going to be micro.

El Dorado, population 12,500, is the home of a small refinery that employs 460, with an additional 150 full-time contractors. In Coffeyville, KS, the population is 10,350, yet another small refinery employs 650 people.

Now, under this bill that was—I do not know the word, some have said it was railroaded, perhaps that is a little harsh, out of the EPW Committee last week. These three communities, and many others in rural Kansas, have told us they will suffer very severe consequences: higher taxes, job loss, even a possibility of shutting down these three refineries, and a greater dependence on volatile foreign energy.

I know the proponents of cap-and-trade proposals talk about green job creation. I think that is probably the topic of the day. Now, I am a seasoned newspaper man, and I get out my trusty, worn Webster dictionary, and I do not find a definition of a green job.

So, my question is: what is a green job? And, why should the Federal Government, with their definition, pickpocket hardworking Kansans with an existing energy industry, as I have just discussed, if, at the end of the bill, there are little or no environmental benefits? Does the scrap yard owner who has Cash for Clunker cars piled up qualify as a green job? How about the steel worker whose product is used in wind energy generation? If that same steel is used in a coal power plant, is it treated differently? Is that a green job?

How about agriculture? If you are the average Kansas farmer or Iowa farmer, or for that matter, Michigan farmer, and you are producing enough food for over 145 people and a whole lot more in a troubled and hungry world, does that farmer represent a green job? Or do you only qualify for a green job label if you participate in the Know Your Farmer, Know Your Food farmer's market on the weekend at the University of Kansas? Ultimately, who determines what is a green job?

Well, I really appreciate Dr. Thorning's opening comment, this is like leading a horse over a cattle guard. I am going to use that, madam, and I will give you credit, something that does not happen very often in the Congress.

What market signals do these two bills show to rural and traditional fuel-dependent States, including coal, oil, gas, and agriculture industries? What would be the ripple effect in the State and government field? I know this is a micro question, but I represent a micro State.

Dr. THORNING. Thank you very much, Senator. I give you that remark, that analogy.

But you might want to take a look at the analysis that the ACCF and NIMS study did on your State. Our study, based on macroeconomic analysis, shows that gross State product in Kansas would be $5 billion less in 2030 compared to the baseline forecast, and that there would be between 21,000 to 29,000 fewer jobs as a result of the Waxman-Markey bill. So certainly, for an energy-intensive State like yours, this bill has pretty serious implications.

Senator ROBERTS. I thank you very much, and thank you, Mr. Chairman. Maybe, perhaps, we could find enough jobs to de-ice the wind turbines when they get iced up just like an airplane. They throw that ice about a quarter of a mile, by the way, so it would take a lot of folks out there to somehow do that.

The CHAIRMAN. Thank you, Senator.

Senator Kerry? You are next.

Senator KERRY. Thank you, Mr. Chairman.

I just might comment for my friend from Kansas, who knows his State better than I do, obviously. But, nevertheless, Siemens just celebrated a groundbreaking of a wind turbine assembly facility there which will employ approximately 400 people.

Senator ROBERTS. I will be at the dedication, by the way. Thank you.

Senator KERRY. I have six studies, which do not get referred to here, six studies: one by the College of Natural Resources, University of California, Berkeley; one by the Center for American Progress Clean Energy Hub; one by the American Council for an Energy-Efficient Economy; one by the Perry Group at the University of Massachusetts Center for American Progress; another by the U.S. Conference of Mayors; and finally, an RDC one; and these are among several. Every single one of them shows Kansas growing in investment, growing in net jobs, and a net reduction in household cost by 2020 on average, about $8.39 per household, a gain to your citizens.

The reason for that—and I am not going to spend a lot of time, because we do not have a lot of time, 5 minutes, obviously. But, this question of assumptions, the question asked by the chairman, is really fundamental to this, folks, and we have to be realistic about them.

I would like to ask unanimous consent that a *Washington Post* op-ed by John Doerr, who is a very well-known venture capitalist in the United States, and Jeff Immelt, the chairman and chief executive officer of General Electric, be made part of the record.

The CHAIRMAN. Without objection.

[The article appears in the appendix on p. 157.]

Senator KERRY. Let me make it clear: these are practitioners. They are not sitting in a theoretical study group. They are out there creating jobs and very, very successfully, I might add. And they wrote in this op-ed that the most basic thing we need to do to get American innovation and competitiveness moving is, number one, send a long-term signal that low-carbon energy is valuable, put a price on carbon, and a cap on carbon emissions.

Now, countless companies—a bunch of them just dropped out of the Chamber of Commerce—have come to the conclusion that is the way you make jobs. We have to make an analysis of these studies, and, frankly, both you, Dr. Green and Dr. Thorning, I just find your studies are not credible.

You do not take into account the cost of inaction. What is it going to cost our taxpayers in the United States if we do not act? What is your plan for meeting a 2-degree Centigrade maintenance of warming on the Earth's temperature? Do you have a plan to do that?

Can you price carbon and accomplish it without moving down one of the two roads that are available to us, either a carbon tax—which everybody here knows the U.S. Congress will not pass, because in order to change behavior it would have to be high enough that just nobody will accept that.

But when you have assumptions that are so out of whack with every other study, for instance, your study, the ACCF study—and the chairman raised this question—your household cost projections are 3 and 4 times higher than the Energy Information Agency, which does this every day, professionally for us, for the government. The EPA, the CBO, on which we base now the healthcare debate and a lot of other debates, you range from $730 to $1,248 as your household cost projection, compared to $80 to $300 for every other one of those studies.

You have not only high allowance forecast prices, but then you make statements, Dr. Green, like the one where you said Europe is not working, the trading system failed. It did not fail. It is working. In fact, they have embraced it, and they are excited about how well it is working. They began a 2-year initial phase, in which they made some mistakes. They acknowledged the mistakes they made, and then they fixed those mistakes.

Now they are in their second phase. In fact, they have an abatement in the first phase, as much as 5 percent down. There was a 1.6-percent drop in EU–15 emissions, contrasted with an increase in GDP of 2.7 percent over that period. They have reduced emissions, they are growing their economy, they are on track to meet their Kyoto targets, and they are a leader in green global technology.

Germany, today, has created more jobs in the green sector of alternative renewables. They have 280,000 people working at new jobs, more people than in their vaunted automobile industry. So, how can you have a study that does not take into effect the impact of energy efficiencies, or of the cost of inaction in not doing it?

We do not have time to go into all of this, but I will just leave you with this. I would like your comment to it.

This is today's Reuters, a story out of London: "The world will have to spend an extra $500 billion to cut carbon emissions for each year it delays implementing a major assault on global warming, the International Energy Agency said on Tuesday." Every year's delay beyond next year will add another $500 billion extra.

Now, I would ask you. Did you take that into account in your studies?

Dr. THORNING. Those are very excellent questions, and there are a lot of them. I will try my best to answer some of them.

First, you ask, did we take account of the environmental impact of not enacting the cap-and-trade legislation?

Well, EPA Administrator Jackson testified recently that, if the U.S. did achieve the targets in the Waxman-Markey bill, it really would not matter by the end of this century because other countries, China and India in particular, are not willing to undertake hard targets.

Senator KERRY. That is not accurate.

Dr. THORNING. Well, the Obama administration——

Senator KERRY. That is not accurate. You have to be accurate. China has said they are going to do a specific energy intensity reduction. It is a 20-percent target. They have set it, and they have exceeded it, thus far.

Dr. THORNING. Well, we will see whether they are able to deliver on that. But until developing countries are willing to take on the same kind of targets that developed countries are, we really, according to EPA's own analysis, will not see meaningful reductions in GHG concentrations.

Second, if you take a look at the studies you mentioned, the Center for American Progress Study and the ACEEE study, which I cite in my testimony, they used input-output analysis.

And let me read from my testimony. This is from the CAP report itself. They identify the problems with their analysis. They state: "There are certainly weaknesses with our use of the input-output model. The most important is that it is a static model, a linear model, and a model that does not take into account the structural changes in the economy." So they admit that there model is inadequate for analyzing the dynamic impact of sharp increases in energy prices.

So, I think, when we look at potential consequences from capping carbon emissions, most experts feel a macroeconomic analysis is the most appropriate. And, once you have looked at a macro model, then you need to look at the assumptions. We feel that the assumptions we embedded in our simulations, using the NIMS model, are appropriate, given what we know about the future development of technology.

So, another thing to think about, I would like to mention two studies, one from Denmark, one from Germany, recent studies looking at the cost to the Danish and German economies of putting in place solar energy. For example, in Germany, a new study by RWI shows each job in Germany is costing about 280,000 euros, each of these solar jobs. There is a study from Denmark showing the wind power jobs are costing the Danish taxpayers approximately 160,000 euros. So, I think we need to be aware of the cost of this type of initiative and balance how quickly we want to move in that direction.

Senator KERRY. My time is up. I do not want to abuse it, but, Mr. Chairman, can I just——

Well, I would just say again—look, I respect that there are costs obviously with transition. But the fact is, the Commerce Department devotes a considerable amount of resources to maintaining the viability of its input-output analysis. And, obviously, there are structural changes that take place. We all understand that. But the ones that have been taking place are to the plus side of the economies of these countries, and to the negative of ours.

For instance, of the top 30 wind-solar battery companies in the world, only 5 are in the United States of America. We invented those technologies. We are losing them to other places. And, I think in the end, your analysis that you just gave us did not answer the question of the costs of inaction, or of how you maintain a 2-degree Centigrade warming without pricing carbon.

Senator GRASSLEY. We will move on. I am going to take my turn now. Senator Baucus is temporarily out.

This would be for each of you, but I do not want too long of an answer, because I have more than one question I want to ask.

The committee has heard testimony in the past from CBO and other economists on a cap-and-trade system that, by diverting resources to reducing greenhouse gas emissions through new technology or a more expensive form of energy that would not otherwise be economical, there is a net cost to the economy.

In other words, carbon limits cannot increase total employment across the economy, with emphasis upon "total." In fact, while there will be some jobs created in certain industries that produce low-carbon energy—and we have had Siemens move into Iowa, so I am well-aware that green energy brings with it jobs—high energy prices will result in a net loss of jobs that otherwise would have been created or sustained in the absence of a cap on carbon. Would everyone on the panel agree with that basic economic principle?

[No response.]

Senator GRASSLEY. All right. Since everybody is quiet, then you agree? All right.

Dr. GREEN. I will say it out loud: yes, I agree with that principle.

Senator GRASSLEY. All right. Do you want to comment, sir? Mr. Breehey?

Mr. BREEHEY. Yes, Senator.

I think it is impossible to not acknowledge that an economy-wide greenhouse gas program would have a net negative impact on GDP. But I think some of the studies, and some of the doomsday scenarios, fail to acknowledge the net negative economic costs associated with the energy efficiency solutions that Senator Kerry referred to, and that those represent some of the least expensive emissions reductions opportunities present in our economy and, over the long run, will have a positive economic impact. So, I think some of the doomsday scenarios that we are hearing are vastly overstated. And, I think, as Senator Baucus alluded to, the innovation that a cap-and-trade program encourages will result in lower costs than most predict.

Senator GRASSLEY. All right. I have a question for Dr. Green.

It is sometimes argued that a cap on carbon, which raises the cost of energy, will create the incentive to develop new technologies or undertake new projects to increase energy efficiency that otherwise would not be pursued, which in the long run will save consumers money. Would you comment on that possibility?

Dr. GREEN. Well, that is a possibility that, indeed, if you raise prices, you will spur research. Consumers will attempt to reduce the cost burden by deploying new technologies. The question is, if those technologies are genuinely efficient—economists do not believe in the idea of $100 bills lying on the sidewalk. If there are efficiencies to be gained where the consumer truly benefits, the consumer will engage in that behavior spontaneously. It does not take the government to tell me that I should pick a $100 bill up off the pavement.

And so, the question is whether these are real or whether they would happen regardless. But it does not offset the net effect that pricing carbon will have an overall net impact on the economy, it will reduce economic growth, and it will reduce jobs.

Senator GRASSLEY. Ms. Ton-Quinlivan, I have a question for you.

I understand that your company is one of the lead advocates of the 50:50 policy found in both the Waxman-Markey and Kerry-Boxer bills, whereby half of the free allowances are given out to energy companies based on retail electric sales as opposed to the actual need for allowances. This rewards companies like your own that have the good fortune to generate a large portion of their energy from hydro-electric. However, it comes at the expense of energy users, like my home State of Iowa, who will see electric bills go up even further if allocations are based solely on need.

A question. Since companies like yours, who because of geography have the ability to generate low-carbon energy, will already be relatively better off under a cap-and-trade system, how can your company justify a policy that further exacerbates the differences between the burdens on constituents in the Midwest, as opposed to those who live in California or New England?

Ms. TON-QUINLIVAN. Senator, since my area of expertise is in the workforce development area, let me constrain my answer to that area.

What we know from California is that our regulators have given us a lot of certainty around the sequence in which we have to prioritize the source of our energy, with energy efficiency on top on the loading order before we can pursue demand reduction, renewables, and conventional sources.

And, what I do know from the energy efficiency side is that, as a result of this certainty, our workforce has 600 people who are focused entirely on energy efficiency, and then we built training programs that have fed over 68,000 trainees into our third-party contractors to do that work.

Senator GRASSLEY. All right. It is Senator Cantwell's turn.

Senator Cantwell?

Senator CANTWELL. Thank you, Mr. Chairman. Thank you very much.

Dr. Green, I do not want to argue with you about whether Europe has succeeded in trading because, frankly, I do not think the United States has. And, the fact that the derivative market still has not had loopholes closed in it is, in my opinion, no reason to start a carbon futures market that might have the same loopholes. In fact, I do know that Europe did cut up carbon futures into tranches, just like we did on the credit default swaps, and it was very unfortunate.

But, I do want to get to your point about SO_2 and CO_2 and the difference, because you were saying that there is something uniquely different about those two markets, and the fact that one, I am assuming, had a more limited impact, and thereby we could achieve results. And so, now you are almost saying a cap and trade is not the right tool. Is that right? It is not robust enough for the challenge that we face? And so, if you could talk about that, and then whether you think a cap-and-dividend model is a little closer to that flexibility that would be needed.

Dr. GREEN. Thank you for your question, Senator.

I would like to praise, by the way, your cap-and-trade bill for its remarkably admirable brevity and its close adherence to what an economist would say cap and trade should look more like.

I would also like to applaud your concern over the financial implications of cap and trade and mortgage-backed securities. I call them, actually, poorly understood financial instruments, or PUFIs, because we are talking about a huge amount of the economy that would be put into these instruments, the energy economy. And we have really no idea what the end result is going to be. If the scheme is not sustainable, the government will burst the bubble, and that could be a very big bubble, indeed.

Now, as to why SO_2 and CO_2 are different, there are many reasons. The first is, with SO_2, you had readily-available scrubbing technology that was only marginally more expensive than operating without. Laws have been changed to allow low-sulfur coal to move across the country to plants that did not have access to it previously. You had a small number of players. You had a single jurisdiction, the United States. You had only one industry sector, so there was not intra-sectoral competition or rent-seeking possible, nearly as much as there is under cap and trade. You had an easily measured pollutant. SO_2 is an active substance, easily measured directly, as opposed to being estimated through inventories or calculated based on the type of fuel input. It was a smaller section of the economy being affected as a whole. And, I would point out that, in fact, if you look at the modeling that was done on the SO_2 trading system, some people say that the industry groups overestimated the cost, and the fact is, they did not.

As they estimated the cost of early bills, the cost estimates were higher. The bills were changed in response to those estimates, and the costs were lowered. The final economic estimates of cap and trade turned out to be very close to the real cost because the earlier estimates had led to changes in the legislation.

This is why the cap and trade—as I said, the economists who developed cap and trade and mathematized it pointed out that cap and trade is for discrete, local, constrained pollutant control. It is an excellent instrument for that, and it can be used for not only pollution control, but also things like tradable quotas for fish, which is another implementation of a market measure, where you cap the withdrawal and you trade the rights to withdraw. But it is not appropriate for greenhouse gas controls.

Senator CANTWELL. And so the point is, that with something where you need a more robust tool to have a cap but then have a price collar, the price collar acts as a more effective tool in keeping the price, and thereby is closer to the carbon tax that you are suggesting.

Dr. GREEN. Well, several things. First, auctioning all permits. If you are going to do cap and trade, you really do not want to get into this freely allocated permit thing because it leads to overallocation, it leads to early inaction in the market. Full auctioning of permits is essential to establish their real value.

Second of all, the price collar. Well, a price collar mitigates some of the problems of cap and trade, but not all. It does mitigate the price volatility element of cap and trade. Again, the difference between SO_2 and CO_2, one of the problems with that is that, when our economy grows, CO_2 levels spike up, as they have spiked down as our economy has tanked. And, when that happens, those permit prices are going to shoot up and become quite volatile, and they will shoot down. A price collar prevents that, but at the same time, it also prevents you from gaining the benefits of a low permit price. You do lose the risk of a high permit price, but you lose the benefit of a low permit price. And, so, it is not a panacea.

Senator CANTWELL. What did you say? PUFI? What did you say?

Dr. GREEN. PUFIs, poorly understood financial instruments.

Senator CANTWELL. All right. Thank you.

Senator STABENOW. Well, as we proceed with our chairman and ranking member having had to leave, I will now turn to my own comments and questions, and then Senator Hatch, and any other members who come in.

Welcome. We appreciate your comments very much.

When I look at this, coming from a State that is known for making things, and doing a very good job of making things, designing things, I look at this whole discussion very much through the prism of jobs and how we keep the next generation of technology manufacturing in this country.

I do not want to see what happened with the computer-age, where we make all the technology and then it is manufactured overseas, so that the President of the United States gives the latest technology in the form of an iPod to the Queen of England, technology from America, made in China.

I think, if that happens around clean energy, we will all have failed, and so I am very much looking at this through the prism of how we create policies that create jobs here. First, a couple of comments. From my perspective, we can either do this well and jobs will be here, or do this poorly and they will not be here.

And so, a number of questions: how we allocate allowances, as well as carbon credits, how we use those; what kind of a border policy; what kind of trade enforcement; what kind of price collar; and there are a whole range of issues that I think we need to be addressing.

I also think it is important, though, for us to acknowledge a couple of things that, while we do not yet have the technology readily available in a number of areas—and Dr. Green, you have spoken about this a number of times—we have the capacity to create the technology, which will create the jobs. Some of this is about timing, I think.

And that is why things like energy efficiency become so important. When the McKenzie Consulting Company reports that the U.S. economy could reduce emissions equal to the entire U.S. fleet of light trucks and cars and save $1.2 trillion through 2020, I think that goes to what we have been trying to do in the Energy Bill around energy efficiencies, buildings, other energy efficiencies, and so on.

The second piece of this is the role of agriculture and forestry, which, while they are not a capped industry under any of the bills, an incredibly important part of capturing carbon, holding carbon, is making sure we are not cutting down our forests, that we are managing them correctly, and we are managing agriculture effectively.

So, I start from the fact that I think there are some bridges that allow us to get there, that allow us to capture carbon and move forward while we are developing the technology.

My questions go to how we, in fact, compete in what I believe is a race with China and other Asian countries as it relates to clean energy jobs. We put a manufacturing credit into the Recovery Act. I was pleased to help champion that, but there is a cap on that. It is going to expire at some point. We have many, many more companies that want to use that than we actually have the amount of dollars in there.

Senator Menendez and I are working on a solar manufacturing credit that would create over 200,000 jobs. I know in my own State, where we make one-third of all of the polycrystalline silicon for the world, and it is shipped overseas, a lot of that to Germany, a lot of that to Asian countries, incentivizing manufacturing means it is going to be here, and we are already starting to see that with the manufacturing credit, and so on.

So, my question goes to the race with China and clean technology jobs. How do we ensure that we retain those jobs here for U.S. workers—and I am sure everyone thinks that that is important—and address our green trade deficit, which is billions and billions of dollars? How do we make sure that, in the end, we are leading in technology industries, including solar, wind, CCS, nuclear, across the board? I would ask anyone who would want to respond to that. How do we make sure we get there?

Dr. GREEN. Well, thank you, Senator.

If I may, I think it is a very important question, and it really comes down to the fact that our manufacturing is more costly than China's is. Their labor costs are much lower. Their environmental standards, while they are good on paper, are often not enforced in practice, allowing them to do a lot more low-cost manufacturing, and it is a serious risk that we will, indeed, send our dollars over there to buy their technologies.

The only thing that I would say could fix that is if China actually accepted a cap on emissions, which I have to correct, Senator

Kerry. An emission intensity target does not mean that your emissions go down. This was pointed out when the Bush administration tried to promote emission intensity measures as their approach to climate change in their Clear Skies proposal. You can become more energy efficient, and your emissions can still grow as your economy grows. So, to say that China has adopted a cap on its emissions is not correct. Until they do, we cannot compete with them on a level playing field.

Senator STABENOW. Well, and I am going to stop at this point and say, what has been happening in America is, we are losing our middle class because we have accepted a race to the bottom.

Saying to people, we can only compete if you work for less and lose your health care and pension, is not how we are going to keep a standard of living in America. There is a better way to do that, I would argue, certainly, if we focus on enforcing a level playing field on trade and if we make the investments that we need to make. But I am wondering if you would like to respond as well. Mr. Breehey? Yes.

Mr. BREEHEY. Thank you, Senator, indeed.

As I alluded to in my testimony, it is tremendously disappointing to the labor movement, those of us who represent workers and manufacturing, that we are seeing the investments—that our tax dollars have been made to promote jobs overseas, and we have to avoid those mistakes when we put together cap-and-trade legislation.

While I know that there are some who will argue that it would be protectionist, we would argue that American jobs are worth protecting, which is why we would say that any technology manufacturer, any power generation company, any wind turbine manufacturer that receives an incentive through a cap-and-trade bill, either through an allocation of allowances or through revenue generated from an auction of allowances, should be required to adhere to domestic content requirements, through the application of laws like the Buy America Act, to the technologies that are going to be produced.

Senator STABENOW. Thank you very much. I notice that I am out of time.

I will just comment that China has adopted a "Buy China" policy. Every other country seems to get it but us in terms of the need to invest in our own jobs at home, so I hope our policy is going to include the ability to create those jobs here.

Mr. BREEHEY. I could not agree more. Thank you.

Senator STABENOW. Senator Hatch?

Senator HATCH. Well, thank you, Madam Chairperson. This has been an excellent group, and I have really enjoyed listening to your testimony.

I would ask unanimous consent that the Americans for Tax Reform's statement be put formally in the record at this point, Madam Chairman.

Senator CANTWELL. Without objection.

Senator HATCH. Thank you.

[The statement appears in the appendix on p. 152.]

Senator HATCH. Now, Dr. Thorning, the Congressional Budget Office released a report this past September entitled "The Economic Effects of Legislation to Reduce Greenhouse Gas Emissions." I would like to highlight several findings from that report.

The increases in the price of energy caused by the program would reduce workers' real wages. The cap-and-trade program for carbon dioxide emissions would reduce the number of jobs in industries that produce carbon-based energy, use energy intensively in their production processes, or produce products whose use involves energy consumption, because those industries would experience the greatest increases in costs and declines in sales.

The industries that produce carbon-based energy—coal mining, oil and gas extraction, and petroleum refining—would probably suffer significant employment losses over time. The process of shifting employment can have substantial costs for the workers' families and communities involved.

Now, Dr. Thorning, other witnesses on this panel have stated that the construction of facilities will create hundreds of permanent jobs in various parts of the country. Now, do you believe that "create" is the right word to use in this context? Should we not say "shift," if it appears that the coal, oil, and gas States would lose a significant amount of jobs and reduction in salaries?

Dr. THORNING. Yes, Senator Hatch. It seems to me what we are looking at is a shift of where resources are deployed. Based on the study that ACCF and NIMS did, as well as other studies cited in my testimony, there would be a shifting of jobs. There would be new, renewable energy, energy efficiency jobs created, but overall, because of the loss of productivity, the premature obsolescence of the existing capital stock, there would be a slowing of economic growth overall, compared to the baseline forecast.

Senator HATCH. Dr. Green, you mentioned that cap and trade has not worked well in Europe. Can you help us understand how and why it has not worked in Europe and whether the bill we are considering today in the Senate would have the same problems as they have faced in Europe?

Dr. GREEN. Well, Senator Kerry pointed out that the first phase of the European Trading System was considered a trial phase. It is not clear if it was originally designed as a trial phase or renamed one after the first time the permit price collapsed.

But, they had repeated collapses of permit price to virtually zero and massive permit price volatility. They had fraud and offsets where they exported quite a lot of money to China for false offsets. They have had protests by various sectors as they have tried to auction more permits, with the result that those sectors have gotten exemption from needing to buy permits, have gotten free allocation maintained for them, and I think all of these structural problems with the carbon market will play out here. We are going to allocate the majority of permits for free. We are not going to auction the majority of permits. We have offset provisions that are going to be problematic, as has been pointed out by others.

Several studies of offsets have shown them to be plagued with fraud and abuse and illegitimacy, so I think we will see many of the same problems play out as has happened with the European Trading System here, but on a broader scale, because we have a very large economy and we have the opportunity to do greater mischief.

Senator HATCH. Well, I am very interested in how a cap-and-trade program would affect the poor. I have heard that the poorest of the poor spend as much as 50 percent of their incomes on energy costs.

Now, in your view, is it possible to construct a cap-and-trade program that reduces carbon emissions, that is not felt by the poor? And, can you explain why it is possible or not possible to protect the poor under such a program, if that is possible?

Dr. GREEN. Well, it is possible to shield them, to a certain extent, by redirecting, if you do auction permit revenues, that revenue to lower-income people.

As you pointed out, low-income people use a disproportionately high amount of their income to pay for energy, not just directly as we have studied at AEI, not just directly in terms of flipping light switches and gassing up their car, but the products that they buy are infused with energy as well, and so their energy costs are disproportionately high.

But on net, ultimately, the point of this exercise is to raise the cost of energy. It was pointed out earlier that a carbon tax is not possible because you would have to raise it so high that nobody would accept it. Well, cap and trade is a carbon tax, it is just applied indirectly, so the permit price will have to rise very high if you are going to see actual change in emissions.

But, to sum up my answers, basically, you can shield them to a certain extent by targeting them with new resources, but overall, as they are going to be mostly affected by the downturn in the economy and the downturn in jobs, they will not be net winners in a cap-and-trade system.

Senator HATCH. All right. Senator Kerry, they apparently did not start the clock when I began, but I have just three more questions. Could I ask those?

Senator KERRY. Absolutely.

Senator HATCH. All right. I appreciate your courtesy in doing that.

Toward the end of your remarks, Dr. Green, you spoke about how under cap and trade we will have winners and losers. Is that true on the international scale? If we implement cap and trade and China and India do not, is there any possible way that our Nation could come out winners under that scenario?

Dr. GREEN. The second question, first. No. If the United States implements cap and trade unilaterally, as Dr. Thorning pointed out, the emission reductions we can achieve as a country pale to insignificance with regard to the growth expected in China and in the rest of the world. There would be no environmental benefit, but we would, indeed, make ourselves considerably less competitive by raising our costs of energy goods and services and manufacturing across the country.

There will be sectoral and regional winners and losers, as was pointed out. Some of the coastal areas have access to greater amounts of hydro, and they have more temperate climates. They have already had to switch to natural gas, in California's case, for traditional air pollutant reasons, whereas the center of the country is more inclined to rely on gas or heavy crudes from Canada, which will be affected by the current legislation.

So, there will be many winners and losers, including internationally. We will impair our economy to the benefit of our competitors.

Senator HATCH. Dr. Thorning, do you agree with that?

Dr. THORNING. Yes, Senator.

Senator HATCH. All right.

Now, just one last question of Mr. Breehey. I appreciate your efforts for your union, and that is great. You mentioned in your remarks that industries such as steel, cement, and chemicals are more sensitive to energy cost increases than other sectors of the economy. Can you help us understand why this is the case, and also what the impact on jobs will be for those industries if S. 1733 were to be enacted as written?

Mr. BREEHEY. Yes, Senator. In the case of a lot of those industries, such as chemicals, energy inputs, both in terms of power use, as well as natural gas feedstocks in the manufacturing process, make them particularly sensitive to price increases and make them particularly sensitive to the impacts of a cap-and-trade program.

I am sorry, sir. I forgot the second part of your question.

Senator HATCH. You are concerned about it, are you not?

Mr. BREEHEY. We are certainly concerned about it, which is why——

Senator HATCH. You would lose a lot of jobs.

Mr. BREEHEY. There are certainly a lot of jobs. As Senator Kerry has pointed out, though, we do have some concern. We feel like we need to take into account the cost of doing nothing.

I represent workers, for example, along the Gulf Coast. If climate change results in more frequent, worse storms, those workers are going to be negatively impacted. So we are trying to think of, what is the right balanced approach that will mitigate negative employment impacts across the economy, both considering the cost of action and the cost of inaction.

But we believe that there are reasonable things that can be done within the context of a cap-and-trade program that would mitigate the negative impacts on workers and energy intensive trade-exposed industries. Those include a robust allocation of allowances to an output-based rebate program, such as has been proposed in S. 1733 and was included in the Waxman-Markey bill. We believe maybe 15 percent of the available allowances should be allocated to such a program.

We also believe that, as has been indicated, it makes no sense for us to take action if major emitters in the developing world fail to follow our lead. We will only result in exporting both jobs and pollution to countries that fail to act, which is why we believe the Senate should certainly include a border measure that would put sort of a carbon tariff on energy-intensive imports from countries that fail to take comparable action.

Senator HATCH. Thank you, Senator Kerry. I appreciate it.

Senator KERRY. Thank you, Senator Hatch.

One thing I might mention, Senator Hatch, because I had something to do with it at the time, I was at the Kyoto negotiations, and none of us was very happy with the outcome of that, and I joined in the effort on the floor when we did the Byrd-Hagel Amendment, because we felt we had to have everybody under the tent, and clearly, that was a failed process.

In arguing with the Europeans that they should undertake the concept of cap and trade, initially they were very opposed to it. They did not believe in it. They saw it as a gimmick by which people did not actually reduce pollution, and so they did not really wholeheartedly embrace it. That is the attitude that governed how they went at the initial execution implementation in Europe with that effort.

The problem is that initially they allocated most of the allowances to emitters, created a windfall profit situation. They had some problems with what they gave to the cement industry, aluminum, others, et cetera. They also had a problem that they did not allow the banking of allowances between those phases, so that allowances became worthless at the end of the initial phase, so that drove the market down. They also had incomplete market data that was released at one point, which scared a lot of people, and it wound up driving the market down.

So, it is fair to say they had some problems and they had a collapse, and I accept all of that. So did they, for that matter. But that is why they put in place a number of reforms. They have begun to transition the amount of auction that they will have, and it is working very effectively now. I have been meeting over these last months with the environment ministers and finance ministers and other leaders, all leading up to Copenhagen, with the idea that, indeed—and I say this to you, Dr. Green, you are absolutely correct—we have to have a global solution. We cannot sit here if the United States does this all by ourselves. We all understand. It is a non-starter.

The President should never think of bringing a treaty here to us that does not have a global component. But it is not fair to say—and I have had this argument with the Chinese—that energy intensity does not result in emissions reductions. It can, depending on where they are reducing the intensity, and how. And you can, in fact, translate a reduction in energy intensity into emissions reductions.

This is the big argument we are having with China right now as we go to Copenhagen, to make certain that what we get out of China, India, Brazil, the middle developing countries, the near-developed countries in some cases, is measurable, and reportable, and verifiable. Those are the key words that have to guide us. If we can get that out of Copenhagen, or beyond Copenhagen—I think we may hopefully get a political agreement there—then we translate it into a real treaty.

I join with other people in saying that we are not going to disadvantage the United States. What is interesting, Senator Hatch, is that other countries are adopting this idea that, indeed, if under an environmental international agreement we all have agreed to a standard of behavior by which we are going to reduce emissions and invest in those efforts, if some country stays outside of that and says, aha, we are going to take advantage of this, and while you guys are busy making your products slightly more expensive or transitioning because you are investing in new capitalization to meet the standard, we are going to take advantage of it and sell in your country and undermine your market. We are not going to let that happen, and other countries are not going to let that happen.

And so, I believe we will for the first time be able to put together a global environmental protocol by which people are agreeing under international law that, if some outlier country decides to try to take advantage of other countries, they are going to be the odd person out, because their products are not going to come in cheaper than the cost of reducing that carbon.

So, that is what a lot of folks have argued on that part of this. That is in the Waxman-Harkey bill. We have changed it in our bill. In fact, this committee will ultimately decide that language, and we need to make it WTO-compliant, and I think we can. But that way, we stand up for the American worker, American businesses, for a fairer playing field, and we have a way, hopefully, of addressing this question.

The final comment I make is that we have to, in these analyses, take into account what happens if we do not do this. The cost of $500 billion a year cannot just be written off. That is going to come back to haunt the American taxpayer, one way or the other: crops that are more expensive to produce, rivers that are more polluted that we have to clean up. You could run the list: fires that are more intense in the west, insurance costs that go up as a result; water that disappears in Montana; agriculture, the heart, the bread basket of the country. These are all very, very serious issues, and they are going to result in massive infrastructure expenditure to pipe water somewhere, or to move whole agricultural sectors of the county to other parts of the country where things will still grow.

What bothers me is, too many of the studies never factor in the benefit of energy efficiency. The MacKenzie Company—which I think, I am sure both of you respect—has done a superb analysis called the Carbon Cost Abatement Curve. That curve shows that, for the first 20 or 30 years of investment, it pays for itself. I can show you Hewlett Packard, IBM, Johnson and Johnson, BP. There are a host of companies across the country that are investing and have reduced their emissions by 20, 30, 50, 60 percent. We are just talking about trying to grab 20 percent over 10 years. They have reduced it in the last 5 or 10 years over that amount, and they are making money, and they have increased their market share.

So, I would like to ask you to take a look at those companies, factor in that practical experience, because I think it speaks volumes to what the potential growth here is for us. And, what I fear is—I do not have the article still, we submitted it—but where a lot of business people are telling me, people like Lewis Hay, who is the chairman of Florida Power and Light, one of the biggest utilities in America, Jim Rogers, chairman and chief executive officer of Duke Energy, who happens to be also the head of the American Competitiveness Council—his job is to make America competitive. He believes that if we just sit here the way we are sitting here and do not do this, China, India, a host of other countries are going to clean our clock economically.

China has set out to be the number-one country in electric car production. They have tripled their wind power targets for next year. They have set a higher standard for automobile emissions than we have. Now, I agree with you, they do not always have the strongest enforcement, and we need to strengthen the enforcement structure as we go to Copenhagen and work at this.

But the fact is, in terms of raw job creation and moving into this sector, if we do not go there, somebody has to explain, to at least this Senator, where America's great job growth is going to come from and what products we are going to compete in, because the fastest-growing sector of every economy anywhere in the world today is in the energy alternative, renewable, and efficiency sector.

And in the 1990s, when Americans made a lot of money, we had a technology boom. It was a $1-trillion market, and there were 1 billion users. The energy market is a $6-trillion market, and there are 6 billion potential users.

If we do not lead in this, I fear the naysayers are stopping our ability to embrace America's next stimulus package, if you will, which is the movement into this pricing of carbon, and other countries are going to beat us to the technologies, and we are going to be sitting there sucking wind.

Maybe you want to respond to that.

Dr. GREEN. Well, thank you, Senator. First of all, I am very glad to hear you say that you do not believe in unilateral action, and I would welcome further discussion of the energy intensity question with you because it is entirely possible—as you said, you can reduce energy intensity and reduce the growth in greenhouse gas emissions. But, on that, you can still grow tremendously in your total actual output of emissions.

I am all in favor of genuine efficiency. I have no problem with genuine efficiencies where there are both energy efficiency gains and economic efficiency gains. But, when you have energy efficiency gains that are not economic, you simply raise your costs of goods and services; it is essentially an argument. You can foster those changes through government incentives, but at the end of the day, you have taken a step that is non-ecomonic and you have, therefore, lost money to your economy that otherwise would have been better deployed elsewhere. That is what markets do, they direct capital to its optimum use. The more you distort those markets, the less optimal the use is and the less your economy grows.

As for the cost of inaction, I was a reviewer on the third assessment part of the IPCC. I looked at the question of what the impacts are. At 2 degrees Centigrade there are very few impacts, in fact, negative, and there are quite a few positive. You do not have significant impact until you reach 3 degrees or higher Centigrade. And it is my opinion, in my assessment of the literature, that we are not likely to reach those levels.

On the other hand, my latest study, which I will be glad to submit for the record, lays out an entire strategy of building social resilience. In the United States, building resilience is climatic resilience for exactly the issues you raised: what happens when that snowpack does not come in a certain area; what happens if sea level rises in a certain area; what happens if you have increased droughts or heavier rainfalls in certain areas? Those can be dealt with completely outside of the carbon control framework.

I have a study that details exactly how you would do that. I will be glad to submit it for the record and come to your office and brief you on it.

[The study appears in the appendix on p. 125.]

Senator KERRY. I would be happy to. Well, I need to run in a moment, but can I cede to you afterwards? How long are you going to be, do you know? Please, go ahead.

Senator HATCH. What bothers me a lot is that, when I was chairman of the Labor and Human Resources Committee, now called the Health, Education, Labor and Pensions Committee, I used to go over to Geneva to the ILO, the International Labor Organization.

Now, a lot of these nations signed up for all of the conventions. We did not. We only signed up for, I think, five or six of them at the time, and we have not signed up for many more since then. But they signed up for these wonderfully glowing conventions that they never lived up to. What I am concerned about, yes, I personally believe China may very well show up at Copenhagen and say, well, we are for all of this, but it is not going to make any difference in what they do.

Now, on this committee, I have worked very hard to have tax credits for wind, solar, geothermal, nuclear, hybrid cars, plug-in hybrid cars, and electrical cars. This is something I have worked very hard on. And all I can say is, the more I get into some of those energy sources, the more I find they are extremely expensive compared to oil, gas, and coal, and that 90 to 95 percent of our total energy needs to come from oil, gas, and coal.

So, as a practical matter, I am very concerned. I think it is wonderful to want to have the world to all live in accordance with the globalization approach towards this, but my experience in the 33 years I have been here is that, if we commit to it, we will live up to it, but a lot of the countries do not. Is that pretty much the way you feel?

Dr. GREEN. If I may, Senator, thank you. That is a very important question. I agree with you. I like all the new technologies, myself. I tried to distill ethanol back when I was a teenager so I could use it to run in our car in 1973, but the BATF would not license me. It is quite expensive.

I am sorry. I just lost my train of thought there; thinking about ethanol now takes my point away.

These technologies are expensive, and that will harm our economic growth. But your point about the treaties is vitally important. This is often misunderstood. Canada, for instance, can agree to a target, and, if they do not do anything, they cannot be sued into compliance by their own government. The U.S. is unique in the status it gives treaties. When we sign a treaty, we live up to it. Other countries can sign treaties and not live up to them.

That is a fundamental difference that makes the United States hesitant to embrace treaties as a general rule, and I think wisely, because treaties have a very high status in American law that is not necessarily reflected in the other countries.

Senator KERRY. Well, actually, Dr. Green, that is not entirely true. I am sorry.

Well, let me tell you why it is not, Senator, because I was at the treaty signing, which we ratified unanimously in the U.S. Senate, the 1992 Framework Convention which George Herbert Walker Bush negotiated, and we did it in Rio, and it has been 18 years since then, or whatever, and we have not done a thing to meet it.

In fact, the last 8 years, emissions in the United States of America, in greenhouse gases, went up 4 times faster than in the 1990s. So, that is the reason we are talking about the need to move to a mandatory reduction, because we did not, and nobody else did either. A few people tried, here and there. So, you just cannot throw that stuff out there like that and say we do it, they do not, blah, blah, blah.

Look, you do not accept that you have to hold it at 2 degrees. You may know something that thousands of other scientists do not. They won a Nobel Prize, you and I did not, and they won a Nobel Prize for their work that said we have to hold it to 2 degrees Centigrade.

The G–20 just went to Italy and came out ratifying that we have to hold it to 2 degrees Centigrade. Now, maybe you know something I do not about where the tipping point is. But I have a lot of scientists whom I respect—from John Holdren, who is now the Science Advisor to the President, to Jim Hansen over at NASA, and a bunch of others—who tell us we have a 10-year window to try to meet the standard of keeping the temperature from rising over 2 degrees Centigrade or you reach the tipping point.

Now, is the tipping point at 2.2, 2.3, 2.5? I do not know. I do not think they would tell you if they know. But they know, because of the consequences of every model that they have looked at, that that is what begins to happen, and all of the evidence is coming back faster and to a greater degree than they predicted, underscoring the predictions they have made.

At some point you have to step back and say these guys are making sense, because what they said is going to happen is happening, and it is happening faster and at a greater risk. To wit, the Chinese, I think Senator Hatch said they do not want to abide by it or they do not care about it. The Chinese are petrified by what is happening in the context of global climate change. The reason? The Himalayan glaciers are disappearing, and the predictions are they are going to be gone by the year 2035. Now, do I know what will happen in 2035? No, but I know what has happened. Every prediction about when the Arctic ice was going to melt has been accelerated to the point now that, instead of 30 years down the road, it is now 2013 that they say we will have an ice-free Arctic in the summer. That is what their predictions are.

Dr. GREEN. I think that has been withdrawn. You might want to look it up.

Senator KERRY. I have not seen that withdrawn. In fact, they had an ice-free passage during last summer. I have not seen that withdrawn. You send me something that says that has been changed. All right? And we will make it part of the record here.

Dr. GREEN. I will do that, Senator. Thank you.

Senator KERRY. So, the bottom line. Every recent scientific update, and I get them periodically, I ask them to come in and say what is happening, is it less than, what is the rate, and without exception they look at me and they say, Senator, I cannot even talk about some of the things that are happening today publicly, because people will not believe it, like columns of methane rising out of the ocean floor that you can light a match and it will explode or ignite where it bursts into the open air because the permafrost is melting. We just voted $400 million to move Newtok, AK. The citizens voted to move it inland because of what is happening in terms of the ice melt. There are, I think, some 400 villages threatened now in Alaska. Ask Lisa Murkowski or Mark Begich what is happening in Alaska.

So, all I can say to you is that we have to employ the precautionary principle here. If I have a few thousand scientists over here, and you have a few others over there, the weight is pretty heavy to say to me that, as a public person, I ought to implement the precautionary principle. And if I have chief executives, like Jeff Immelt and Lewis Hay and Chad Holliday of DuPont, and a bunch of other people who run Fortune 500 companies telling me, Senator, we have to price carbon and we want certainty in the marketplace, I am going to listen, unless you can give me an overpowering reason why those guys are all wrong, and I do not think you have.

Dr. GREEN. All I can say, Senator, is I read the IPCC reports, the Science of Climate Change report, in its totality, cover to cover, and I follow the latest journals. My doctoral degree is in environmental science and engineering. I daresay I am capable of understanding the literature and forming my own opinion.

Senator KERRY. Has your study been peer-reviewed?

Dr. GREEN. No, I do not work in the peer-reviewed literature, Senator. I do not work for a university.

Senator KERRY. So, you do not submit your studies for any peer review?

Dr. GREEN. No.

Senator KERRY. You realize that there are something like 2,000 or 3,000 studies all of which concur which have been peer-reviewed, and not one of the studies dissenting has been peer-reviewed.

Dr. GREEN. That is not correct, Senator.

Senator KERRY. Show me a peer-reviewed study.

Dr. GREEN. I will send you a list.

Senator KERRY. Please, because nobody else has.

Dr. GREEN. I will be glad to.

Senator KERRY. And, in Al Gore's book, he cites the same fact, that nobody has ever contradicted it with a peer-reviewed study.

Dr. GREEN. I will be glad to send you some studies, Senator.

Senator KERRY. I look forward to it.

We stand adjourned. Thank you.

[Whereupon, at 12:05 p.m., the hearing was concluded.]

APPENDIX

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

Hearing Statement of Senator Max Baucus (D-Mont.)
Regarding Potential Climate Change Legislation and Job Creation

In 1971, the noted economist and Harvard dean Edward Mason said:

"There seems to be no reason to believe . . . that the employment-creating effects of restoring the environment will be any less than those involved in polluting the environment."

It seems that the debate over jobs and the environment has been around about as long as we have had either jobs — or an environment.

Today, we will consider whether climate legislation will create jobs in the energy sector. We'll examine further this Committee's role in climate legislation. And we'll discuss what we can do both to create jobs and to ease the transition to an economy that accounts for the cost of carbon dioxide.

I am committed to passing meaningful, balanced climate-change legislation. I am committed to legislation that will protect our land and those whose livelihood depends on it.

I want our children and grandchildren to be able to enjoy the outdoors the way that we can today. So I'm going to work to pass climate-change legislation that is both meaningful and that can muster enough votes to become law.

Today we'll hear predictions — some optimistic, some otherwise — about the effects that climate legislation will have on American jobs and the American economy. We need to consider these predictions. But we also need to consider the consequences of failing to act.

We can already see some of these consequences in my home state of Montana. We can see the consequences in forests near my hometown of Helena, destroyed by pine beetles that thrive in warmer temperatures. We can see the consequences in sustained drought and more-frequent wildfires. And we can see the consequences in decreased snowpack and lower stream flows, reducing water for irrigated agriculture and starving our blue-ribbon trout streams of cold water.

These are serious consequences. And I believe that we can mitigate their effects in a way that does not harm the economy.

History is instructive on this point.

As a senior Senator on the Environment and Public Works Committee, I wrote much of the bill that became known as the Clean Air Act Amendments of 1990. That legislation established a cap-and-trade system to curb sulfur dioxide emissions. It helped to combat acid rain.

During the debate on that bill, several industry studies made dire predictions about the effects of the legislation on the economy. Even studies from the Environmental Protection Agency estimated annual costs of between $2.7 and $4 billion a year.

And during that debate, there were also dire predictions about job losses. In 1990, the EPA predicted that between 13,000 and 16,000 coal mining jobs would be lost as a result of the acid rain program.

But a decade later, an EPA analysis determined that the cost of cutting emissions was far lower than they had expected. Reaching the sulfur dioxide goals set by the 1990 Amendments cost an estimated $1-to-2 billion a year. That was less than half their original estimates.

And the EPA found that job loss was about one-fourth of what was predicted. About 95 percent of the job loss that did occur was due to productivity gains in the industry. Very few jobs were lost due to the acid rain program itself.

Let me be clear. We should work to minimize any job losses.

But we should recognize that in the case of acid rain, the negative consequences were far less than projected. We should keep this in mind when similar claims are made about the effects of legislation to address climate change.

And we should recognize that the Bush Administration noted how cost-effective the acid rain program was. The Bush Administration found that its benefits exceeded its costs by more than 40 to 1.

To be fair, the scope of climate-change legislation is far broader. And while we must always be mindful of the cost of legislation, that's particularly true in today's economy. Our unemployment rate remains far too high. And we must be diligent to create jobs, including in the energy sector.

Again, we can point to some success.

In recent years, Congress has extended and modified the tax credit for production of power from renewable sources, such as wind and biomass. With that credit, wind turbine and turbine component manufacturers announced, added, or expanded more than 70 facilities in the U.S. in 2007 and 2008. These facilities, when fully online, will represent 13,000 new direct jobs.

I am also very interested in a new incentive that we wrote earlier this year — a 30 percent credit for "advanced energy" manufacturing. We passed this credit to spur domestic production of clean energy equipment. I will be keeping a close eye on implementation of this credit, both in terms of energy independence, and for creating jobs.

I look forward to hearing our witnesses' views. I look forward to further consideration of these issues in the Finance Committee. And I look forward to our efforts to protect both jobs and our environment.

Carol L. Berrigan
Senior Director, Industry Infrastructure
Nuclear Energy Institute

U.S. Senate
Committee on Finance

Washington, DC
November 10, 2009

Testimony for the Record

Chairman Baucus, Ranking Member Grassley and members of the Committee, I appreciate this opportunity to express the nuclear industry's views on future jobs under climate legislation.

I am Carol Berrigan, senior director of industry infrastructure at the Nuclear Energy Institute (NEI). NEI is responsible for establishing unified nuclear industry policy on regulatory, financial, technical and legislative issues affecting the nuclear industry. NEI members include all companies licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

Let me begin by thanking the members of this committee for your long-standing oversight of the nation's fiscal affairs and for your support of legislation like the production tax credit for new nuclear generation as passed in EPAct 2005 and the tax credit afforded under the American Recovery and Reinvestment Act of 2009 for investments in new or expanded capacity to manufacture components for clean energy technologies. Both of these programs are important initial steps toward the financial incentives necessary to accelerate the deployment of nuclear energy generation and rebuild the nation's manufacturing infrastructure.

My testimony today will cover three major areas:

1. the role of nuclear energy under climate legislation
2. the impact of new nuclear generation on the work force and manufacturing base
3. recommendations that are essential to expanding nuclear energy to meet the nation's climate and energy goals

1. The role of nuclear energy under climate legislation

Today, the 104 reactors operating in the United States are among our nation's safest and most secure industrial facilities. In addition, they are the nation's lowest cost producer of base-load electricity, averaging just 1.83 cents per kilowatt-hour. These 104 nuclear power plants produce one-fifth of America's electricity.

U.S. utilities are preparing to build advanced-design nuclear power plants to meet our nation's growing electricity demand. Currently, 13 applications for 22 new reactors are under active review by the Nuclear Regulatory Commission. Over $4 billion has been spent on new nuclear plant development over the last few years, including the ordering of long-lead components, and the industry plans to invest approximately $8 billion in the next few years to be a in a position to start construction of the first new reactors in 2011-2012.

Nuclear energy holds great potential for meeting our nation's future climate-related goals. Today, nuclear energy represents more than 72 percent of the nation's emission-free generation portfolio, avoiding nearly 700 million metric tons of carbon dioxide per year. To put this in perspective, the emissions avoided are equal to removing 133 million of the approximately 136 million passenger cars from the nation's roads. In addition, U.S. nuclear generation has avoided 2.65 million short tons of sulfur dioxide and 0.91 million short tons of nitrogen oxide compared to the fossil fuels that would have been burned in the absence of nuclear energy. [1]

On a life-cycle basis, all energy generation technologies emit some amount of CO_2 during the manufacture of components (whether it be pressure vessels, wind turbines or photovoltaic cells) and during other activities not directly associated with the production of electricity at the power plant. A number of studies by organizations such as the Organization for Economic Co-operation and Development have concluded that nuclear energy's emissions "footprint," including all of the activities to build and provide fuel for nuclear plants, is comparable to that of renewable generation sources.

As Congress and the administration turn greater attention to climate legislation, mainstream analyses of the climate change issue by independent organizations show that reducing carbon emissions will require a portfolio of technologies and that nuclear energy must be part of the portfolio. Further, they indicate that major expansion of nuclear generating capacity over the next 30 to 50 years is essential.

Analyses of H.R. 2454, the American Clean Energy and Security Act, which passed the House on June 26, by the Environmental Protection Agency (EPA) and the Energy Information Administration (EIA) demonstrate that substantial increases in nuclear generating capacity will be essential to meet the legislation's carbon-reduction goals.

In the EPA analysis, nuclear generation increases by 150 percent, from 782 billion kilowatt-hours (kWh) in 2005 to 2,081 billion kWh in 2050. If all existing U.S. nuclear power plants retire after 60 years of operation, 187 new nuclear plants must be built by 2050.[2] In the EIA's analysis, in the "Basic" scenario, the U.S. would need to build 96 gigawatts of new nuclear generation by 2030 (69 new nuclear plants). This would result in nuclear energy supplying 33 percent of U.S. electricity generation, more than any other source of electric power. [3]

When examining the portfolio of technologies that will need to be deployed in order to meet climate goals, the Electric Power Research Institute's (EPRI) "The Power to Reduce CO_2 Emissions: The Full Portfolio" analysis indicated that that there is no single technology that can, by itself, slow and reverse increases in carbon emissions. A portfolio of technologies and approaches will be required.

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[1] Emissions avoided by nuclear power are calculated using regional fossil fuel emission rates from the Environmental Protection Agency and plant generation data from the Energy Information Administration.

[2] Environmental Protection Agency, "Analysis of H.R. 2454, American Clean Energy and Security Act of 2009"

[3] Energy Information Administration, "Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009." The "Basic" scenario represents an environment where key low-emissions technologies – including nuclear, fossil with carbon capture and sequestration and renewables – are developed and deployed on a large scale in a timeframe consistent with the emissions reduction requirements of H.R. 2454 without encountering any major obstacles.

The EPRI analysis starts with the Energy Information Administration's forecast of electric sector carbon emissions in 2030, then assembles the portfolio of technologies that could reduce the electric sector's carbon emissions to 1990 levels by 2030. All the elements in the portfolio represent maximum feasible deployment, so failure to develop and deploy the full portfolio would place unsustainable stress on the other technologies in the portfolio.

EPRI's analysis concludes that reducing U.S. electric sector carbon emissions to the 1990 level would require:

- aggressive efficiency programs to reduce electricity demand growth to less than 1 percent per year
- 135,000 megawatts (MW) of new renewable energy capacity (instead of the 60,000 MW in the EIA's reference case)
- significant improvements in the efficiency of existing coal-fired and gas-fired power plants and widespread deployment of carbon capture and storage beyond 2020
- accelerated deployment of plug-in hybrid electric vehicles and electro-technologies
- 64,000 MW of new nuclear generating capacity, in addition to the 100,000 MW now operating.[4]

In addition to producing carbon-free electricity, expansion of nuclear energy generation will serve other national imperatives. Construction of new nuclear power plants will create tens of thousands of jobs in project development, construction, operations and manufacturing. A robust nuclear construction program will also significantly expand the U.S. manufacturing sector and the domestic nuclear supply chain.

2. The impact of new nuclear generation on the work force and manufacturing base

Thanks to increasing world demand for new nuclear reactors, American companies have an unprecedented opportunity to expand the nuclear manufacturing base in the United States and open new international markets to domestic suppliers. American firms have the potential to expand production and repurpose existing infrastructure to re-emerge as world leaders in the nuclear industry. In the process, nuclear suppliers can contribute substantially to job creation, economic development and reduction of greenhouse gas emissions.

Since the interest of this committee is the impact of climate legislation on the work force, I will begin by describing the size of the work force needed to support the current nuclear industry and new nuclear construction. The nuclear industry faces several challenges in meeting its future work force demands, but with these challenges come significant opportunities for American workers.

Current Nuclear Power Plants: Each nuclear unit in operation today directly employs 400 to 700 people.[5] In addition to direct employment, the nuclear industry relies on numerous vendors and specialty contractors for additional expertise and services. For maintenance and outages, nuclear plants also require skilled labor to compliment full-time utility staff, in some cases as many as 1,000 additional workers over a 4 to 8 week period, depending on the scope of the outage work. Based on an extrapolation of data supplied from the Associated Maintenance Contractors, over 30 million man-hours are worked by supplemental craft labor each year at the nation's 104 nuclear reactors.

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[4] Electric Power Research Institute, "The Power to Reduce CO2 Emissions: The Full Portfolio," first release was in August 2007, updated again in December 2008 and again in July 2009.

[5] For some single unit sites, the number of workers may exceed 1000. In addition to direct employment, each plant creates economic activity that generates roughly an equivalent number of additional jobs within the local community and produces approximately $430 million annually in expenditures for goods, services and labor, and through subsequent spending because of the presence of the plant and its employees. The average nuclear plants also contributes more than $20 million annually to state and local tax revenue, benefiting schools, roads and other state and local infrastructure and provides annual federal tax payments of $75 million.

NEI's 2009 nuclear work force survey indicated that 38 percent or 21,600 current nuclear utility employees will be eligible to retire within five years (2009 to 2014). In addition, the industry continues to experience non-retirement attrition, which over the same five-year period may require replacement of an additional 10 percent of the nuclear utility work force or 6,000 workers.

Existing nuclear power plants generate substantial economic value in addition to payroll spending. In 2008, nuclear companies procured over $14 billion in materials, fuel and services from over 22,500 domestic suppliers.[6] Ongoing operation and maintenance of existing nuclear power plants provides substantial economic benefit for American manufacturers.

While only 31 states have nuclear power plants, nuclear procurement takes place in all 50 states, with an average of $277 million of procurement occurring per state. States with the top procurement include Maryland, with over $1.9 billion; Pennsylvania, with over $1.8 billion; and North Carolina, with over $1.2 billion of procurement. Of particular interest to the members of this committee may be the fact that last year $555 million was procured from over 1,200 companies in Florida, $463 million was procured from over 1,600 companies in New York, $415 million was procured from over 1,400 companies in Massachusetts, $352 million was procured from over 1,550 companies in Texas and $259 million was procured from over 1,050 companies in New Jersey.

New Nuclear Power Plants: The resurgence of nuclear energy will lead to increasing demand for skilled labor at all levels. According to a recent analysis by the National Commission on Energy Policy, the development of a nuclear power plant project will require 14,360 man-years per gW installed. [7] These jobs include skilled crafts such as welders, pipefitters, masons, carpenters, millwrights, sheet metal workers, electricians, ironworkers, heavy equipment operators and insulators, as well as engineers, project managers and construction supervisors.

If the industry were to construct the 22 units that are currently under active Construction and Operating License (COL) review, this would require almost 316,000 man-years of labor. Once built, these 22 plants would require 8,800 to 15,400 permanent full-time workers to operate the plants and additional supplemental labor for maintenance and outages.

Supply Chain: The nuclear supply chain represents a major opportunity for American manufacturers to expand capacity to meet the needs of the growing world nuclear power market. Today, there are 53 nuclear power plants under construction around the world. In addition, there are 137 plants on order or planned in 26 countries and 295 projects under consideration in 36 countries[8]. This represents a significant opportunity for U.S. based suppliers and they are responding by adding staff and capacity, and developing additional manufacturing facilities. Over the past few years, we have seen a significant increase in the number of domestic nuclear suppliers. ASME Section III Nuclear Certificates (commonly called "N-stamps") held in the U.S. have increased 22 percent since the beginning of 2007—from 221 in January 2007 to 269 in May 2009.

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[6] Procurement numbers are based on a Nuclear Energy Institute survey of member companies. The numbers include all data received by NEI through October 31, 2009. Procurement of nuclear services includes fees paid to regulatory agencies. The referenced number of domestic suppliers includes all organizations from which the industry procured over $1,000 worth of materials, services or fuel in 2008.

[7] Task Force on America's Future Energy Jobs, National Commission on Energy Policy, 2009, Appendix A: Bechtel Report on Design and Construction. Man-year numbers include salaried and hourly man-years.

[8] "World Nuclear Power Reactors & Uranium Requirements," World Nuclear Association, Sept. 2009

Today, U.S. manufacturers of components for new nuclear power plants and fuel cycle facilities are adding to design and engineering staff, expanding their capability to manufacture nuclear-grade components, and building new manufacturing facilities in preparation for new reactor construction in the U.S. and abroad. In excess of 15,000 new U.S. jobs have been created to date due to new nuclear plant activities. Manufacturing and technical service jobs have been created in Virginia, North and South Carolina, Tennessee, Pennsylvania, Louisiana and Indiana. These jobs include engineering services and the manufacture of components including pumps, valves, piping, tubing, insulation, reactor pressure vessels, pressurizes, heat exchangers and moisture separators to name a few.

3. Recommendations that are essential to expanding nuclear energy to meet the nation's climate and energy goals

A program to expand reliance on nuclear energy to meet U.S. climate change goals, even if it only approaches the scale indicated by EPA and EIA analyses, will require a sustained partnership between federal and state governments and the private sector, including additional policy support from the federal government.

Financing is the single largest challenge to accelerated deployment of new nuclear power plants. The financing challenge for the industry is structural. New nuclear power plants require large capital investments to be made by relatively small companies. While the financing challenges are different for the regulated integrated utilities than for the merchant generating companies in those states that have restructured, they can be managed.

An effective, long-term financing platform is necessary to ensure deployment of clean energy technologies in the numbers required and to accelerate the flow of private capital to clean technology deployment. The loan guarantee program authorized by the 2005 Energy Policy Act was an important step in the right direction, but the scale of the challenge requires a broader financing platform than the program envisioned by Title XVII.

Additional federal tax stimulus is also an important element that would accelerate capital investment in new nuclear power plants and in the critical manpower and infrastructure necessary to build new nuclear power plants in the numbers required to reduce carbon emissions. Tax incentives could help refill the pipeline of highly trained personnel needed to build, operate and maintain new nuclear power plants and restore America's ability to manufacture the components and other equipment that go into nuclear power plants in the U.S. and abroad, thereby creating additional jobs.

To provide the level of financial stimulus necessary to accelerate deployment of nuclear energy consistent with the nation's climate and energy goals, we encourage you to:

1) Create a permanent financing platform (the Clean Energy Deployment Administration, or CEDA) to provide loans, loan guarantees and other credit support to clean energy technologies, including new nuclear power plants and new nuclear equipment manufacturing facilities. We encourage you to

support the CEDA legislation approved earlier this year by the Senate Energy Committee that would absorb the Title XVII loan guarantee program into CEDA, not impose limitations on financial support to any particular technology and provide at least $100 billion in additional loan volume, in addition to the funding already authorized for the Title XVII loan guarantee program.

2) Provide tax stimulus for investment in new nuclear power plants, new nuclear-related manufacturing and work force development and expand the existing production tax credit provided by the 2005 Energy Policy Act.

1. Amend the production tax credit authorized by 2005 Energy Policy Act to:
    a. remove the 6,000-megawatt national megawatt limitation and make the credit available to all reactors placed in service before January 1, 2025
    b. allow public power entities to transfer credits allocated to them (by virtue of their ownership position in a nuclear power plant) to tax-paying partners in the project
    c. index the credit for inflation

2. If companies so choose, in lieu of the production tax credit authorized by the 2005 Energy Policy Act, provide a 30 percent investment tax credit for investment in new nuclear power plants on which construction begins on or before January 1, 2025, or upgrades to increase output from existing nuclear power plants, available on an annual basis during construction as investments are made (qualified progress expenditure credits). Allow credits to be used against the alternative minimum tax. Allow companies to elect a grant in lieu of the credit.

3. Amend the 30 percent investment tax credit (provided in the American Recovery and Reinvestment Act of 2009 for investments in new or expanded capacity to manufacture components for clean energy technologies) to:
    a. state explicitly that nuclear energy is a qualifying technology
    b. expand the value of the credit to $5 billion (from $2.3 billion)
    c. extend from 3 years to 7 years the time period allowed between certification of a project by the secretary and when the project must be placed in service

4. Reduce and eventually eliminate tariff and non-tariff barriers to international trade in nuclear plant components while providing expanded investment stimulus to develop U.S. manufacturing capability for nuclear goods and components where such capability does not exist .

5. Provide a tax credit for the expenses of training workers for nuclear power plants and facilities producing components or fuel for such plants. This credit could serve to accelerate hiring and allow industry to utilize a broader range of work force training solutions including apprenticeship programs, community college-based education programs and specialized technical training not currently available via public educational institutions.

6. Amend Section 468A of the Internal Revenue Code to allow non-rate-regulated licensees that may be required by the Nuclear Regulatory Commission (NRC), as part of their operating license requirements, to pre-fund decommissioning costs to obtain a current income tax deduction as such contributions are made. (For example, some taxpayers may be required to pre-fund decommissioning costs in one year and the tax deduction for such costs should correspond to that one-year period.)

Mr. Chairman, in conclusion, the role of nuclear energy in achieving the nation's climate goals is clearly established. The expansion of nuclear energy in the U.S. and globally provides a significant opportunity for American workers and industry, increasing high-wage employment and significantly expanding our domestic manufacturing sector. I encourage you and this committee to continue your legacy of leadership on these issues and promote legislation that would provide the necessary financial stimulus to realize these goals.

Senate Finance Committee Hearing
Climate Change Legislation: Considerations for Future Jobs
November 10, 2009
Nuclear Energy Institute Responses to Follow-Up Questions

Questions from Senator Baucus

1. **You stated in your testimony that building a new nuclear facility requires a wide range of workers, including pipefitters, welders, electricians and ironworkers. In your opinion, to what extent are jobs in the energy sector interchangeable? To what extent will new jobs in low-carbon industries offset any decrease in energy-intensive and trade-exposed industries?**

   While many of the skilled craft jobs (welders, pipefitters, electricians, ironworkers, etc.) across the energy sector require similar skills regardless of the generating technology that is employed, additional training or certifications may be required to perform required work.

   Revitalization of the nuclear industry will continue to create thousands of jobs for skilled craft laborers and engineers. Over $4 billion of private capital has already been spent in preparation for new nuclear construction and manufacturing in the U.S., which has created over 15,000 jobs. Although NEI is not in a position to comment on specific numbers of job losses in other industries, retooling America's manufacturing infrastructure to build components to meet global demand for new nuclear reactors will restore thousands of skilled craft jobs that have been lost in the industrial sector.

2. **Several news recent reports indicate that China is making great strides in the development and manufacture of clean-energy technology. An August 2009 *Christian Science Monitor* article notes that Chinese factories already make a third of the world's solar cells – six times more than the U.S., and that last year China graduated 17 PhDs in the field of underground coal gasification, while only two others graduated in the rest of the world.**

   Please comment on China's green technology developments and the impact these will have on green technology and jobs in the United States. Please also share your thoughts on the U.S.'s opportunity to engage in similar technology development and job creation, such as through incentives like the new advanced energy manufacturing credit Congress passed in February.

   The International Atomic Energy Agency and the World Nuclear Association report that China currently has 11 operable nuclear reactors, 19 reactors under construction, 35 planned reactors and 90 proposed reactors.[1] China is expanding their nuclear fleet more rapidly than the United States and is actively expanding manufacturing capability to support new nuclear plant deployment. However, 47% of all ASME Section III Nuclear Certificates[2] are currently held in the U.S. Many of the reactors being constructed in China are based on U.S. technology or are being provided by vendors with U.S. manufacturing facilities, so there are still significant opportunities for domestic expansion of manufacturing and jobs if it is clear that the U.S. will also build new reactors.

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[1] "World Nuclear Power Reactors & Uranium Requirements," World Nuclear Association, September 2009

NEI supports incentives such as the advanced energy manufacturing credit passed by Congress to encourage technology development and job creation. Due to the scale of the investments required to fully develop domestic manufacturing infrastructure for clean energy technologies, the dollar amount of the manufacturing credits available should be increased to $5 billion from the current $2.3 billion and the deployment time-frame expanded to at least 7 years from the current 3 years. These changes will ensure that the U.S. is in a position to capture more of the manufacturing base for the global deployment of clean energy technologies that will otherwise be developed overseas.

NEI is not in a position to comment on China's expansion in other technologies such as solar and coal gasification.

3. **Through the right clean energy policies, there is a potential to create thousands of new jobs in the U.S. We know there are various sectors that could experience job growth, but we need to have a skilled workforce in place to meet the demand. How do we ensure our workforce is trained and ready to seize these new opportunities? And as new technology is developed, how do we ensure our training programs equip Americans with durable, in-demand skills? How would you suggest we address the need to keep newly acquired skills fresh?**

There are several means to help ensure that our workforce is trained and ready to seize new opportunities. Federal support is still needed to ensure the work force is fully trained. The series of recommendations in the National Commission on Energy Policy's Task Force on America's Future Energy Jobs provide a solid foundation in this area.

Further programs to provide tax credits to employers for worker training and additional appropriations to support educational programs that meet industry recognized training standards are needed.

To train workers to address the needs created by retirements, attrition, and new plant construction, the nuclear industry has developed partnerships with 52 community colleges. These programs are implementing standardized, uniform curricula to ensure that graduates will be eligible to work at any nuclear plant.

Funding is required to support infrastructure purchases at the community colleges and universities to ensure our students have the equipment needed for a global level education, for scholarships and fellowships to ensure the programs have capable domestic students enrolled, and to develop and implement programs to prepare American skilled workers to construct and operate new nuclear facilities.

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[2] "BNCS Ex-Officio Report," ASME Committee on Nuclear Certification, June 17, 2009

Questions from Senator Cantwell

1. **In addition to thinking about the costs of policy action on climate change, we need to be just as aware of the potential costs of inaction. There is going to be tremendous energy growth, particularly in the developing world, over the next century. Energy is already a $6 trillion market, and it is growing fast. I want to be sure that the United States is the world's leading supplier of clean energy technologies to meet the exploding world demand.**

   - **How should policymakers create and structure incentives that enable US leadership in clean energy technologies? Is a consistent, stable price on fossil carbon an effective or necessary component?**

     NEI has proposed a series of policy initiatives to ensure the U.S. can regain a leadership position on the development and manufacture of technology for the production of nuclear energy. The attached paper, "Legislative Proposal to Help Meet Climate Change Goals", outlines our recommendations. If taken in whole, these measures would ensure that the U.S. nuclear industry is ready to serve domestic and global markets which will create thousands of jobs.

     Although a price on carbon would clearly benefit all clean technologies, the implementation of such a policy must protect consumers and the economy. For more information on the utility industry's recommendations for implementation of carbon policies, see *www.smartclimatepolicy.org*.

   - **How do you think we should balance the protection of existing industries with the promotion of future industries? Isn't there a real risk that if we fail to create the right investment incentives at home, we may miss out on the lucrative opportunities that will accompany global leadership in clean energy?**

     The Nuclear Energy Institute believes that the greatest government support should be given to industries that best meet our national objectives. Nuclear energy increases our energy independence while providing low-cost, clean, base-load power that drives the U.S. economy. The deployment of U.S. civil nuclear technology also provides an opportunity to expand the American manufacturing base, create jobs, increase exports and re-emerge as a world-leader in this growing market.

     The window of opportunity to restore our nuclear energy manufacturing capability will not remain open indefinitely. China has unambiguously embraced nuclear power and has moved aggressively to begin construction on 19 reactors. Other countries such as India (6 reactors under construction) have done likewise. The worldwide nuclear renaissance will not pause and wait for the United States. U.S. manufacturers are most likely to succeed if U.S. technology can be licensed and exported in a timely fashion. If this does not occur, it is possible that we will miss out on lucrative opportunities that accompany global leadership in this sector.

To expand manufacturing capability and exports for nuclear energy related components, we need to expand incentives for investment in manufacturing facilities and embrace the construction of nuclear reactors domestically. The attached paper on NEI's proposed policies to support the expansion of nuclear energy in the U.S. provides detailed recommendations that would ensure the U.S. does not miss out on the opportunity to expand clean energy infrastructure and growth opportunities.

2. **One of the most important ways we can stimulate economic growth and job creation through climate policy is by creating consistent price signals and long-term incentives for investment in innovation and new energy technologies.**

    - **In any policy involving the auctioning of emissions allowances, do you think that price controls—both price floors and ceilings—are necessary to manage volatility and uncertainty?**

      The scope of this issue is better addressed by the Edison Electric Institute. Please visit *www.smartclimatepolicy.org* for the utility perspective on the requirements for a successful program to reduce carbon emissions.

    - **Would a well-designed, price collar (i.e. explicit upper and lower bounds for the price of allowances) provide sufficient assurances for substantial investment in capital-intensive, low-carbon energy systems such as CCS and nuclear, as well as other, more conventional renewable energy technologies?**

      A tax on carbon via emissions allowances or other means will improve the business case for all clean energy technologies. However, it is likely that allowances alone will not address the need for access to low cost capital. To build new nuclear in the numbers required to meet emissions reduction targets, low cost capital through the expansion of the Title XVII loan guarantee program or the creation of the Clean Energy Deployment Administration as described in S. 1462 will be required. The attached paper outlines these and additional proposals to support the deployment of new nuclear plants to support climate change goals.

Questions from Senator Carper

1. **Ms. Berrigan, in your statement you mention there are 13 active new nuclear applications before the NRC. These new nuclear reactors will use technology much more advanced than the 1960s and 70s technology found in our current nuclear fleet – correct?**

    Yes. All of the applications for new plants currently under review by the NRC are advanced-design light water reactors. While these new plant designs are based on proven technology, they incorporate design and operational enhancements from over 30 years of

U.S and worldwide experience. New plants will be easier to operate and maintain and feature increased margins of safety as evidenced by a significantly lower calculated risk of damage to the nuclear fuel in the reactor core. Use of digital instrumentation and controls represents the biggest advance in technology over current U.S. reactors, and will enhance plant safety, availability, and reliability. In addition, all new plants feature design enhancements to protect against very unlikely severe reactor accidents and enhanced fire protection by design through physical separation of redundant safety systems.

2. **Nuclear energy is a huge job builder – right now more than 70 firms in Delaware alone provide nuclear energy-related services, such as manufacturing components. To meet our future nuclear needs, it is my understanding that four billion dollars in investments have already been made to support the manufacture of nuclear components, resulting in 15,000 jobs – but we have a long way to go to meet the manufacturing needs of a new nuclear renaissance – correct?**

   This is correct. The deployment of new nuclear plants provides an almost unparalleled opportunity to expand American manufacturing as companies rebuild and retool to produce the pumps, valves, vessels and other nuclear-grade equipment needed for new nuclear plants. For example, the equipment and commodities required for the first eight plants to come on line will include the following:[3]

   - Nuclear-grade valves – 4,000 to 24,000
   - Nuclear-grade piping – 30-150 miles
   - Pumps –1,000 to 2,000
   - Large and small heat exchangers – 500 to 1300
   - Cable – over 1,800 miles
   - Concrete – over 3 million cubic yards
   - Electrical components – over 700,000
   - Structural & reinforcing steel – ~500,000 tons

   To meet the manufacturing needs for domestic and global expansion of nuclear energy, NEI advocates providing tax stimulus for new nuclear-related manufacturing and work force development, and expanding the existing production tax credit provided by the 2005 Energy Policy Act. Specific recommendations to meet manufacturing needs are included in pages 3 and 4 of the attached "Legislative Proposal to Help Meet Climate Change Goals."

3. **In the stimulus bill, we provided a 30 percent tax credit for manufacturers to re-equip, expand, or establish facilities that will produce clean or efficient energy property (48C) – including nuclear. Do you believe this tax credit will help spur more manufacturing of nuclear components here at home? Should we extend this tax credit? Can we do more?**

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[3] "Manufacturing Capacity Assessment for New U.S. Nuclear Plants," NEI, April 2007

NEI supports incentives such as the manufacturing tax credit included in the stimulus bill. The nuclear industry believes that this tax credit is an important first step in spurring the manufacturing of nuclear components in the U.S. However, the manufacturing tax credit is limited in scope to $2.3 billion across all technologies. Due to the scale of the investments required to produce nuclear components and other clean energy technologies, NEI recommends an increase in the dollar amount of the manufacturing credits to $5 billion and an extension of the timeframe to bring a project on line to at least 7 years from the current 3 years. These changes will ensure that the U.S. is in a position to capture more of the manufacturing base for the global deployment of clean energy technologies that will otherwise be developed overseas.

Manufacturers are also monitoring support for construction of new nuclear plants in the U.S. Several companies have already invested private capital for new facilities and expansions to support construction of reactors in the U.S. and abroad as described in the attached fact sheet titled, "New Nuclear Plants Create Opportunities To Expand U.S. Manufacturing, Create Jobs". If the policies to support new plant financing and construction described in the attached legislative proposal are enacted, manufacturers will have more assurance of a domestic market to support further expansion and related job growth.

4. **What are the potential export opportunities for nuclear suppliers and how can the U.S. Senate support U.S. commercial competitiveness abroad? How will the manufacturing tax credit (48C) support industry efforts for expansion, including to foreign markets?**

Nuclear energy expansion is already underway internationally with 53 plants under construction worldwide. U.S. manufacturers are most likely to succeed globally if U.S. technology can be licensed and exported abroad in a time-frame consistent with the global build-out.

While the manufacturing tax credit will help U.S. companies expand production (see the response to question 3 above), it does not address some of the critical issues concerning tariff and non-tariff barriers to international trade. To address these issues and promote the expansion of U.S. manufacturing abroad it is necessary to reduce and eventually eliminate tariff and non-tariff barriers to international trade in nuclear plant components, including:

a) suspension of any U.S. tariffs on imported goods and components if no U.S. manufacturing capability exists
b) suspension of any U.S. tariffs on imported goods and components if the country of origin eliminates, or has eliminated, tariffs on nuclear goods and components imported from the United States
c) investment stimulus to develop U.S. manufacturing capability for nuclear goods and components where such capability does not exist, and
d) coordinated federal support for U.S. nuclear exports including active support for implementation of the CSC (Convention on Supplemental Compensation for Nuclear Damage).

5. **With more than 38% of the current nuclear workforce eligible to retire in the next five years, how successful are we (government programs, industry outreach efforts, etc) in preparing the next generation of the nuclear workforce and keeping jobs and skills in the U.S.?**

    Current grant programs for nuclear energy work force development available from the Department of Energy, Nuclear Regulatory Commission and the Department of Labor have provided much needed support for curriculum development, scholarships and fellowships, research and skills training. These funds have been put to good use in repairing a declining nuclear education system in the United States. For example, enrollment in nuclear engineering departments is up over 500% from 1999.

    However, as described in an earlier response to Senator Baucus, further support is still needed to ensure the work force is fully trained. Funding is required to support infrastructure purchases at the community colleges and universities to ensure our students have the equipment needed for a global level education, for scholarships and fellowships to ensure the programs have capable domestic students enrolled, and to develop and implement programs to prepare American skilled workers to construct and operate new nuclear facilities.

6. **Working with my colleagues in EPW, we provided funding (over $500 million) for nuclear science programs and for nuclear workforce training in the climate change bill. Training money that can help support operating jobs and construction jobs. Do you feel we've taken the right step to train our next generation of nuclear workers?**

    Yes. The proposed legislation has taken the right step to supporting the next generation of nuclear workers. Section 132 provides further authorization for the nuclear science talent expansion grants and nuclear science competitiveness grants provided for in Section 5004 of the America COMPETES Act. The disciplines included under the Act are in such areas as nuclear science, health physics and nuclear chemistry that are not currently supported by the Department of Energy (DOE) at either the Office of Science or the Office of Nuclear Energy. These disciplines are vital not only to the operation of nuclear power plants but also to fuel cycle facilities, medical facilities, the Nuclear Regulatory Commission, and DOE national labs. Section 132 also includes support for the training of new workers skilled in the construction and operation of nuclear power plants. This legislation would dramatically improve the ability of the Department of Labor to offer help to new and upgraded skilled craft programs, community college programs, training of construction management programs and integrated regional work force programs.

Questions from Senator Grassley

1. **My question relates to why nuclear is not already a bigger part of our nation's energy mix. Is it because nuclear is somewhat more expensive to generate and therefore cannot compete effectively without a policy that raises the cost of fossil fuels, or is it**

more related to some of the obstacles you raised in your testimony like financing? Under the first scenario, it would seem like the job opportunities you mentioned in your testimony would come at the expense of other jobs, in manufacturing for instance, that depend on lower cost energy. However, if there are obstacles unrelated to climate policy that can be overcome to make nuclear a source of abundant low-cost energy, shouldn't we pursue those regardless of whether we enact a cap and trade system?

Nuclear energy's expansion has been stalled because of the long timeline required for the first wave of nuclear project development and significant capital requirements for nuclear plant construction. More than other sources of base load generation, nuclear energy has a higher up-front capital cost and relatively low variable expenses for operations, maintenance, and fuel. Although the levelized cost of power from nuclear plants is competitive, the requirement to provide significant upfront capital is daunting for many companies since the U.S. electricity market is made up of a mix of utilities, municipalities, and co-operatives rather than only a few large producers as in other nations. In addition, the first new plants are requiring a forty-two month licensing period that is longer than the entire development cycle for many other technologies.

Several studies have shown that the levelized cost of power from new nuclear plants is competitive with other energy generating technologies. For example, MIT's Center for Energy and Environmental Policy Research issued a report titled "Update on the Cost of Nuclear Power," May 2009, that showed new nuclear plants are cost competitive at 6.6¢/kWh (vs. 6.2¢/kWh for coal and 6.5¢/kWh for gas) if the technology risk premium is removed from the financing assumptions (i.e., when the first few plants have been built and investors are confident that they can be built to cost and schedule). The study also shows that nuclear plants become increasingly competitive as the price of carbon increases. The example provided in the report showed that a $25/ton carbon tax would increase the price of coal-fired generation to 8.3¢/kWh and gas-fired generation to 7.5¢/kWh (nuclear remains at 6.6¢/kWh).

To promote the development of nuclear energy in the U.S., the top priority should include access to low cost capital. Expansion of the loan guarantee program, which provides financial support for the construction of new reactors at no cost to taxpayers, would help increase the number of new nuclear projects under construction in the U.S. A long-term platform such as the Clean Energy Development Administration language proposed in the American Clean Energy Leadership Act from the Senate Energy and Natural Resources Committee would similarly ensure the access to low cost capital for qualified projects. Certainty about the availability of financing will give developers the confidence to continue investing the private capital required to develop new nuclear plant projects.

The time required for project development should be addressed in the second wave of nuclear plants. The time to complete the Nuclear Regulatory Commission's (NRC) licensing process for new reactors should be reduced significantly for a combined operating license in the second wave of applications. If companies have pursued an early site permit and use a certified design, the review and approval of a COL should require two years or less since much of the material in the application will have already been approved by the NRC. Recommended improvements to remove redundancy from the NRC process are outlined in the attached paper titled, "Legislative Proposal to Help Meet Climate Change Goals." In addition, the construction times for the first reactors are estimated at five years while the U.S rebuilds domestic infrastructure to support new plant construction. Similar to the experience in Japan and Korea, we should be able to improve the time required to build standardized designs to four years or less. Reducing the project development time to six years or less will reduce risk for the project sponsors and lenders.

Questions from Senator Cornyn

1. **With 104 nuclear power plants in operation today, how many direct jobs are provided? How many indirect jobs exist to support the plants?**

   Direct employment at the nuclear plants is around 57,000 employees. Our economic analyses have found that one direct job at a nuclear plant creates about one indirect job. With the creation of additional jobs in support of new nuclear plants over the past few years, the U.S. commercial nuclear industry is currently estimated at more than 120,000 workers.

2. **What barriers exist today to prevent new nuclear plants from going forward?**

   As described above in the response to the question from Senator Grassley, access to financing and time to market are the most significant barriers for expansion of nuclear energy in the U.S. NEI has proposed a series of policy initiatives to ensure the U.S. can regain a leadership position on the development and manufacture of technology for the production of nuclear energy. The attached paper, "Legislative Proposal to Help Meet Climate Change Goals", outlines our recommendations. If taken in whole, these measures would ensure that the U.S. nuclear industry is ready to serve domestic and global markets which will create thousands of jobs.

3. **How many manufacturing jobs exist or are anticipated for new nuclear plants?**

   To date, over 15,000 new jobs have already been created across the nation, including at sites in Virginia, North and South Carolina, Tennessee, Pennsylvania, Louisiana and Indiana. Since January 2007, the number of ASME Section III certificates (commonly called "N-stamps"), which are required to produce nuclear-grade components, has increased 22%.

   Ultimately, the number of new manufacturing jobs which are created will depend on the number of new plants built, and on the ability of domestic manufacturers to participate in the international markets (see the response to Senator Carper question 4 above) and access to incentives for manufacturers and suppliers to assist them in capacity expansion.

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LEGISLATIVE PROPOSAL TO HELP MEET CLIMATE CHANGE GOALS BY EXPANDING U.S. NUCLEAR ENERGY PRODUCTION

Nuclear Energy: A Strategic Part of the Portfolio to Reduce Carbon Emissions

All mainstream analyses of the climate change issue by independent organizations show that reducing carbon emissions will require a portfolio of technologies, that nuclear energy must be part of the portfolio, and that major expansion of nuclear generating capacity over the next 30-50 years is essential.

Analyses of H.R. 2454, the American Clean Energy and Security Act, which passed the House on June 26, by the Environmental Protection Agency (EPA) and the Energy Information Administration (EIA) demonstrate that substantial increases in nuclear generating capacity will be essential to meet the legislation's carbon-reduction goals.

In the EPA analysis, nuclear generation increases by 150 percent, from 782 billion kilowatt-hours (kWh) in 2005 to 2,081 billion kWh in 2050. If all existing U.S. nuclear power plants retire after 60 years of operation, 187 new nuclear plants must be built by 2050. In EIA's analysis, in the "Basic" scenario,[1] the U.S. would need to build 96 gigawatts of new nuclear generation by 2030 (69 new nuclear plants). This would result in nuclear energy supplying 33 percent of U.S. electricity generation, more than any other source of electric power. To the extent the United States cannot deploy new nuclear power plants in these numbers, the cost of electricity, natural gas and carbon allowances will be higher.

A program to expand reliance on nuclear energy to meet U.S. climate change goals, even if it only approaches this scale, will require a sustained partnership between federal and state governments and the private sector, including additional policy support from the federal government.

Increasing America's reliance on nuclear energy will, of course, serve other national imperatives besides production of carbon-free electricity. Construction of new nuclear power plants will create tens of thousand of jobs – to build the plants themselves and to produce the components and materials that go into the plants. A nuclear construction program will also breathe new life into the U.S. manufacturing sector, as it rebuilds and retools to produce the pumps, valves, vessels and other nuclear-grade equipment needed for new nuclear plants.

The Nuclear Energy Institute[2] has developed proposed legislation designed to support this broad-based expansion. This paper summarizes the policy initiatives in NEI's legislative proposal.

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[1] The "Basic" scenario represents an environment where key low-emissions technologies – including nuclear, fossil with carbon capture and sequestration and renewables – are developed and deployed on a large scale in a timeframe consistent with the emissions reduction requirements of H.R. 2454 without encountering any major obstacles.

[2] NEI is responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including regulatory, financial, technical and legislative issues. NEI members include all companies licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

Financing New Nuclear Plant Construction

Financing is the single largest challenge to accelerated deployment of new nuclear power plants. The financing challenge is structural. New nuclear power plants are large capital investments – likely $6-8 billion for a new reactor – being built by relatively small companies.[3] The U.S. electric power sector consists of many relatively small companies, which do not have the size, financing capability or financial strength to finance power projects of this scale on their own, in the numbers required – particularly since the same companies will also be investing in other forms of generating capacity, transmission and distribution, efficiency and demand response programs, and environmental controls.

The financing challenges are different for the regulated integrated utilities than for the merchant generating companies in those states that have restructured. But these challenges can be managed, with appropriate rate treatment from state regulators,[4] credit support in the form of federal loan guarantees, tax-related stimulus for investment, or a combination of these.

Loan Guarantees. Loan guarantees are a powerful tool and a highly efficient way to expand the availability of private capital. Loan guarantees allow the companies to use non-recourse, project-finance-type structures, so they offset the disparity in scale between project size and company size. Loan guarantees allow higher leverage in the project's capital structure, which reduces the project's cost of capital. These benefits flow to the economy by allowing the rapid deployment of clean generating technologies at a lower cost to consumers.

The loan guarantee program authorized by the 2005 Energy Policy Act was an important step in the right direction, but the scale of the challenge requires a broader financing platform than the program envisioned by Title XVII.[5] An effective, long-term financing platform is necessary to ensure deployment of clean energy technologies in the numbers required, and to accelerate the flow of private capital to clean technology deployment. Proposals to create a Clean Energy Deployment Administration are included in the energy and climate change legislation moving through the Senate and the House.

Tax Incentives. Federal tax stimulus would serve two purposes – accelerating capital investment in new nuclear power plants and in the critical manpower and infrastructure necessary to build new nuclear power plants in the numbers required to reduce carbon emissions. Tax incentives could refill the pipeline of highly trained personnel needed to build, operate and maintain new nuclear power plants, and restore America's ability to manufacture the components and other equipment that go into nuclear power plants, thereby creating additional jobs.

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[3] The largest U.S. investor-owned power company has a market value of approximately $30-35 billion and a book capitalization of about $10 billion. The other companies in the sector are significantly smaller. In comparison, the larger European electric companies are two or three times larger, and are better able to finance large-scale projects on balance sheet.

[4] Supportive state policies include recovery of nuclear plant development costs as they are incurred, and Construction Work in Progress or CWIP, which allows recovery of financing costs during construction. Many of the states where new nuclear plants are planned – including Florida, Virginia, Texas, Louisiana, Mississippi, North Carolina and South Carolina – have passed legislation or implemented new regulations to encourage construction of new nuclear power plants by providing financing support and assurance of investment recovery. By itself, however, this state support may not be sufficient. The federal government must also provide financing support for deployment of clean energy technologies in the numbers necessary to address growing U.S. electricity needs and reduce carbon emissions.

[5] Until new legislation is enacted, the Department of Energy's existing loan guarantee must continue and must be provided sufficient loan guarantee authority. The existing program currently authorizes $18.5 billion in loan guarantees for nuclear power projects. This is clearly inadequate, given the $6-8 billion expected cost of a new nuclear power plant. Loan volume authorized for nuclear power projects must be commensurate with the cost of these projects.

NEI's legislative proposal to ensure successful financing of new nuclear power plants includes all of these elements. The tax stimulus proposed for new nuclear power plant construction would provide new nuclear power plants the same tax-related support currently provided to renewable energy sources. To provide financial stimulus, the proposed legislation would:

1) Create a permanent financing platform (the Clean Energy Deployment Administration) to provide loans, loan guarantees and other credit support to clean energy technologies, including new nuclear power plants and new nuclear equipment manufacturing facilities.

   Both House[6] and Senate[7] legislation authorize creation of CEDA. Differences between the two proposals must be reconciled:

   - *The House legislation establishes CEDA as a free-standing government corporation; the Senate legislation creates CEDA as an independent entity within the Department of Energy.*
   - *Under the Senate legislation, CEDA would absorb the Title XVII loan guarantee program; under the House legislation, it would not. The nuclear industry supports the Senate provision.*
   - *The House legislation would impose a limitation of 30 percent on financial support to any single technology; the Senate version has no such limitation. The nuclear industry supports the Senate position.*
   - *The House legislation provides sufficient capitalization to support loan volume of at least $75 billion; the Senate, $100 billion. The nuclear industry regards $100 billion as a minimum acceptable additional loan volume for CEDA, in addition to the $111 billion already authorized for the Title XVII loan guarantee program.*

2) Amend the Energy Policy Act of 2005 to:

   - Clarify certain provisions of Title XVII to address difficulties that have arisen during implementation of the loan guarantee program.

     Both House and Senate legislation include technical corrections to Title XVII, although they are not identical. For the nuclear industry, the most important change involves collateral-sharing, addressed in both House and Senate bills, but imperfectly. The nuclear industry's preferred clarification would make it clear that the Secretary of Energy has discretion to require such collateral for a loan guarantee as the Secretary determines appropriate to protect the interests of the United States in the case of a default. The industry's proposal would also make clear that the Secretary can enter into intercreditor arrangements to provide for sharing of collateral, priority of liens and control of remedies. This clarification is essential to allow co-financing of nuclear projects, in which Export Credit Agencies (ECAs) in other countries or undivided interests provide debt financing side-by-side with the DOE-guaranteed debt.[8]

     Other required technical changes include: allowing the credit subsidy cost to be paid by a combination of appropriations and payments by project sponsors; removing the requirement (in Section 504(b) of the Federal Credit Reform Act) for authorization of loan volume in an appropriations bill in situations where the project sponsor pays the credit subsidy fee; and creating a revolving fund under which administrative fees collected by DOE can be recycled to cover the operating expenses of the Loan Guarantee Office. (Absent this provision, the administrative fees collected by DOE are treated as

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[6] H.R. 2454, the American Clean Energy and Security Act, which passed the House on June 26.

[7] S. 1462, the American Clean Energy Leadership Act, which was approved by the Senate Energy and Natural Resources Committee on June 17.

[8] A rule change proposed by DOE on August 6 would accomplish this objective. Statutory clarification would be protect against future misunderstandings or misinterpretations, however.

general revenues to the Treasury, and DOE must request appropriations every year to cover the costs of operating the loan guarantee program.)

- Improve the Standby Support risk insurance authorized by the 2005 Energy Policy Act, which protects project developers from schedule delays caused by factors beyond their control, such as licensing inefficiencies or frivolous litigation. The amendments proposed would expand the scope of coverage.
  These amendments would:
  1. *Retain the six-plant limit in the Energy Policy Act, but allow the coverage to roll over to the next plant if it is not exercised.*
  2. *Increase the coverage on all six contracts to $500 million.*
  3. *Allow coverage of all delay costs (not just debt service) incurred by a project developer due to licensing, litigation or political factors beyond the project developer's control.*
  4. *Eliminate the requirement that a project sponsor must absorb six months of delay costs before coverage begins.*
  5. *Provide for independent arbitration of claims under American Arbitration Association (AAA) Commercial Arbitration Rules, rather than the approach prescribed by DOE in its final regulations (claims adjudicated by a DOE Board of Contract Appeals).*

3) Provide tax stimulus for investment in new nuclear power plants, new nuclear-related manufacturing and work force development, and expand the existing production tax credit provided by the 2005 Energy Policy Act.

- Amend the production tax credit authorized by 2005 Energy Policy Act to:
  a) remove the 6,000-megawatt national megawatt limitation and make the credit available to all reactors placed in service before January 1, 2025
  b) allow public power entities to transfer credits allocated to them (by virtue of their ownership position in a nuclear power plant) to tax-paying partners in the project, and
  c) index the credit for inflation.

- If companies so choose, in lieu of the production tax credit authorized by the 2005 Energy Policy Act, provide a 30 percent investment tax credit for investment in new nuclear power plants on which construction begins on or before January 1, 2025, or upgrades to increase output from existing nuclear power plants, available on an annual basis during construction as investments are made (qualified progress expenditure credits). Allow credits to be used against the alternative minimum tax. Allow companies to elect a grant in lieu of the credit.

- Amend the 30 percent investment tax credit (provided in the American Recovery and Reinvestment Act of 2009 for investments in new or expanded capacity to manufacture components for clean energy technologies) to:
  a) state explicitly that nuclear energy is a qualifying technology
  b) expand the value of the credit to $5 billion (from $2.3 billion), and
  c) extend from 3 years to 5 years the time period allowed between certification of a project by the Secretary and when the project must be placed in service.

- Reduce and eventually eliminate tariff and non-tariff barriers to international trade in nuclear plant components, including:

a) suspension of any U.S. tariffs on imported goods and components if no U.S. manufacturing capability exists
b) suspension of any U.S.tariffs on imported goods and components if the country of origin eliminates, or has eliminated, tariffs on nuclear goods and components imported from the United States
c) investment stimulus to develop U.S. manufacturing capability for nuclear goods and components where such capability does not exist, and
d) instruction to the U.S. Trade Representative to negotiate elimination of tariffs on import and export of nuclear components among nuclear supplier nations.

- Provide a tax credit for the expenses of training workers for nuclear power plants and facilities producing components or fuel for such plants. The credit would be graduated and based on a percentage of wages – e.g., 40 percent of the qualified first-year wages of qualified workers, 30 percent of the qualified second-year wages, 20 percent of the qualified third-year wages of qualified workers. The credit would apply to participants in a U.S. Department of Labor Registered Apprenticeship program (or a participant in a State Apprenticeship Program recognized by the U.S. Department of Labor) and participants in an accredited program of the Institute of Nuclear Power Operations' National Academy for Nuclear Training.

- Amend Section 468A of the Internal Revenue Code to allow non-rate-regulated licensees that may be required by the Nuclear Regulatory Commission (NRC), as part of their operating license requirements, to pre-fund decommissioning costs to obtain a current income tax deduction as such contributions are made. (For example, some taxpayers may be required to pre-fund decommissioning costs in one year and the tax deduction for such costs should correspond to that one-year period.)

- Remove new nuclear generating capacity and uprates to existing nuclear power plants from the baseline used to calculate a company's compliance obligation with any renewable portfolio standard.

Implementing a More Efficient, Transparent Licensing Process

The time to market for the first nuclear power plants to be licensed under the new Part 52 licensing process can be reduced. This can be done by providing clarification on the nuclear plant licensing process established in the 1992 Energy Policy Act, to ensure that the improvements in licensing envisioned in that law are achieved. Greater efficiency can be achieved by eliminating redundancies and duplication in the licensing process and improving the transparency of the process – not by limiting environmental reviews mandated by the National Environmental Policy Act or by limiting public participation.

The amendments proposed should help to ensure that: (1) the first combined construction/operating licenses (COLs) can be issued in 2011, provided rulemakings to certify underlying designs are completed, and (2) the licensing process does not cause unnecessary delays in authorization to load fuel. With these amendments, if subsequent COL applications reference an early site permit (ESP) and a certified design, current 9-10-year licensing and construction schedules could be reduced to approximately six years: 24 months for licensing and 48 months for construction and start-up.

The efficiency of the licensing process can be improved by:

- Directing the NRC to use informal procedures for any hearing on Inspections, Tests, Analyses and Acceptance Criteria (ITAAC), and directing the NRC to implement legislative hearing procedures within one year of enactment. This would be consistent with NRC practice for other licensing hearings.

- Eliminating the potential for misinterpretation and misunderstandings during the later stages of construction by amending Section 185(b) of the Atomic Energy Act thus: "Following issuance of the combined license, the Commission shall ensure that the prescribed inspections, tests, and analyses are performed and, prior to operation of the facility, shall find that the prescribed acceptance criteria ~~are~~ *have been* met."

  The word "are" in the second-to-last sentence of Section 185b creates implementation difficulties for the Nuclear Regulatory Commission (NRC) and companies during construction. During construction of a new nuclear power plant and before fuel load, the licensee must perform inspections, tests and analyses of components, systems and subsystems to demonstrate that those components, systems and subsystems meet acceptance criteria set forth in the COL. These are known as ITAAC (for Inspections, Tests, Analyses and Acceptance Criteria) and there are typically as many as a thousand of them included in a COL. These ITAAC will be conducted during construction and accepted by the NRC as they are completed. When all the ITAAC have been met, the facility is eligible to operate, subject to a finding to that effect from the NRC. The use of the word "are" in Section 185b implies that ITAAC acceptance is a continuing process with no defined end point. Changing the word "are" to "have been" simply makes it clear that an ITAAC that has been completed successfully and accepted by the NRC is sufficient.

- Eliminating the mandatory uncontested hearing required before issuance of a combined license or an early site permit for a power reactor.

  The mandatory hearing is an artifact of the old two-step licensing process and no longer serves a useful purpose. This would amend Section 189a(1)(A) of the Atomic Energy Act (AEA) to eliminate the requirement to conduct a hearing and make findings on uncontested issues for every COL and ESP application.

  Section 189a(1)(A) of the AEA requires the Nuclear Regulatory Commission (NRC) to conduct hearings in two situations. First, if an intervenor has demonstrated the requisite standing and has submitted one admissible contention, then the NRC will conduct a contested hearing on those contested issues raised by the intervenor. In a contested hearing, the parties submit evidence and testimony, which the Atomic Safety and Licensing Board ("ASLB") uses to make factual and legal findings on the issues raised by the intervenors. Second, independent of any contested hearing or contested issues, the NRC must conduct a hearing on uncontested issues for every Combined Operating License ("COL") or Early Site Permit ("ESP") application. This is the so-called "mandatory" hearing. Intervenors are not allowed to participate in the hearing on uncontested issues. In the uncontested hearing, the ASLB is merely to decide whether the Staff's review of the application has been adequate to support its findings (i.e., conduct a "sufficiency" review). This section amends Section 189a(1)(A) to eliminate this requirement to conduct a hearing and make findings on uncontested issues for every COL and ESP application. Since the proposal does not eliminate hearings on contested issues – that is, issues raised by intervenor – the proposal does not impact intervenors' existing rights to request a hearing, introduce proposed contentions, or otherwise participate in contested hearings. Instead, the proposal simply eliminates a redundant and unneeded "review of the Staff's review."

- Directing the Nuclear Regulatory Commission to seek efficiencies by using the Environmental Impact Statement (EIS) from an Early Site Permit proceeding to analyze and prepare the EIS for a combined license proceeding. This will expedite required environmental reviews in the case where the combined license application is referencing an early site permit.

  An early site permit application requires the applicant to submit an environmental report, which is reviewed by the NRC and from which the NRC staff generates the environmental impact statement (EIS) required by the National Environmental Policy Act. A combined license application referencing an early site permit requires an environmental report to be submitted, from which the NRC develops another EIS. The only difference in scope between the early site permit EIS and the combined license EIS should be an assessment of the environmental impact of "new and significant" information. The combined license EIS should build on the early site permit findings and conclusions.

- Directing the NRC to amend its regulations to allow the draft EIS into evidence in a proceeding held on the proposed licensing action, providing an earlier opportunity to adjudicate environmental issues. Hearing proceedings on a combined license and an early site permit should begin on issuance of the draft EIS; they should not wait until the final EIS and the final safety evaluation report have been issued. A final decision in a license proceeding could not occur, of course, until the final EIS has been issued.

- Avoiding unnecessary use of judicial resources by precluding a court from finding liability for a "public liability action" under the Price-Anderson Act if no violation of the applicable regulatory safety standards occurred. This change would simply prevent spurious legal challenges if a licensee is in compliance with all applicable federal radiation protection standards.

- Clarifying the scope and responsibilities of the NRC and the Department of Homeland Security with respect to commercial nuclear plant security, by affirming that the Department of Homeland Security is the governing agency for determining the security threats applicable to all of the U.S. critical infrastructure, including nuclear facilities. The existing NRC-defined design basis threat (DBT) would provide the basis for licensee security strategies and activities that are the subject of NRC security inspections on the date of enactment of this Act.

  Federal and state law enforcement and security forces are responsible for defending U.S. critical infrastructure from all credible threats. In the case of nuclear facilities licensed by the NRC, an integrated response by plant security forces and local, state and federal authorities would be implemented for all threats, including those within the NRC's DBT. Mitigating or responding to any threats beyond the NRC's DBT, as it exists on the date of enactment, would be the responsibility of local, state and federal authorities, supported by licensee security forces to the extent of their capability. Federal and state law enforcement and security forces shall establish communication and coordination protocols and procedures to ensure effective defense of U.S. critical infrastructure against coordinated attacks by a group or groups of armed terrorists.

- Amending the Energy Reorganization Act to allow a Commissioner of the NRC to continue in office, until whichever of the following occurs first: (1) the Commissioner's successor is sworn in, or (2) the expiration of the next session of Congress subsequent to the expiration of the Commissioner's fixed term of office. Such "holdover" provisions are found in the organizational statutes of most independent regulatory agencies, and prevent gaps in agency leadership.

Providing Direction to the Federal Government's Used Fuel Management Program

NEI's legislative proposal does not include major reorganization and restructuring of the federal government's used fuel management program. Although such restructuring is necessary for the long-term, it should be pursued through regular order, with development of an appropriate hearing record, as a bipartisan initiative, rather than added to current energy/climate change legislation. This set of policy initiatives therefore includes only limited provisions dealing with used fuel – creation of a Blue Ribbon Commission to re-examine used nuclear fuel management (if the Administration has not already established an appropriate scope and staff for the commission), definition of the commission's scope, a statutory finding of waste confidence, and financial incentives for development of interim storage facilities.

- Mandate creation of a Blue Ribbon Commission to re-examine used nuclear fuel management and define the commission's scope, provide a statutory finding of waste confidence, and provide financial incentives for development of interim storage facilities.
  The Senate legislation mandates creation of the Blue Ribbon Commission and defines its scope. It does not provide a statutory finding of waste confidence, nor does it provide incentives for states and/or localities to develop and host interim storage facilities. The House legislation has no provision on used nuclear fuel.

Nuclear Fuel Supply

- Enhance uranium market transparency by codifying in law the excess uranium inventory management plan (announced by the Department of Energy on December 16, 2008) should be codified into law. This policy addresses the disposition of excess government uranium inventories, balances the needs of DOE programs, electric utility consumers of uranium, and domestic fuel cycle suppliers.

- To ensure that uranium is recognized as a mineral of strategic importance, Congress should impose a high statutory standard for government land withdrawals, with such actions reviewed and justified every five years.

National Support for Nuclear Energy, Research and Development and Other Provisions

- Obtain a Sense of the Congress resolution on the strategic importance of nuclear energy.

- Create a National Nuclear Energy Council, modeled on the National Petroleum Council, to provide advice and counsel to the Secretary of Energy. This will help ensure that federal resources and efforts are focused on the areas where they will have the greatest effect.

- Authorize a multi-year nuclear energy R&D program for technology development and demonstration of advanced nuclear fuel cycles (including direction to the NRC to develop a regulatory framework and the standards necessary to license facilities necessary to close the nuclear fuel cycle).

- Authorize a multi-year government-private sector program for the development and NRC certification of two small scalable innovative (less than 1,000 megawatts thermal) modular reactor designs that will be certified by the NRC before January 1, 2018.

- Authorize a multi-year government-private sector program for the development, NRC review and approval of a combined license for two small modular reactor designs and any first-of-class demonstration of features that are unique to the design and operation of multi-unit modular reactors and that will achieve commercial power operation by January 1, 2021.

- Authorize a federal interagency working group charged with promoting the export of nuclear products and services to the rapidly growing global nuclear market.

- Expand the National Institute of Standards and Technology's Manufacturing Extension Program, which is designed to provide technical assistance to U.S. manufacturers as they improve their processes and increase their competitiveness. This section will direct NIST MEP to support the transition of current manufacturers to enter the nuclear supply chain and create a working capital fund for small to mid-sized businesses to assist in this transition.

NUCLEAR ENERGY INSTITUTE

December 2009

New Nuclear Plants Create Opportunities To Expand U.S. Manufacturing, Create Jobs

New Nuclear Plants a Key Part of Technology Portfolio to Reduce Carbon Emissions

As concern about air pollution and climate change have grown, so has interest in, and support for, construction of new nuclear plants. There are 104 nuclear reactors operating in the United States today, and the industry is well along with development of new nuclear projects. Currently, 13 applications for 22 new reactors are under active review by the Nuclear Regulatory Commission. Over $4 billion has been spent on new nuclear plant development over the last several years, including the ordering of long-lead components, and the industry plans to invest approximately $8 billion in the next several years to be a in a position to start construction of the first new reactors in 2011-2012.

Key Facts

- Worldwide[1]
  - 53 plants under construction
  - 137 plants on order or planned in 26 countries
  - 295 projects under consideration in 36 countries
- Domestic[2]
  - 4-8 new reactors in operation by 2016-2017 (site preparation underway for first movers)
  - Possibility of 45 new plants by 2030[3]

New Plants Will Require Increased Infrastructure

Deployment of new nuclear power plants in the numbers necessary to reduce carbon emissions depends on a robust supply chain of nuclear manufacturers. Construction of new nuclear plants requires hundreds of components and subcomponents, which in turn requires a deep and diverse supplier base.

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[1] "World Nuclear Power Reactors & Uranium Requirements," World Nuclear Association, Sept. 2009

[2] Nuclear Energy Institute (NEI) projection

[3] According to the Electric Power Research Institute's analysis, *The Power to Reduce CO_2 Emissions: the Full Portfolio*, 64,000 megawatts of new nuclear capacity are needed by 2030 as part of the technology portfolio necessary to reduce carbon emissions to 1990 levels by 2030. This is equivalent to building about 45 new nuclear plants.

Key Facts

Equipment and commodities required for the first eight plants to come on line will include the following:[4]

- Nuclear-grade valves – 4,000 to 24,000
- Nuclear-grade piping – 30-150 miles
- Pumps –1,000 to 2,000
- Large and small heat exchangers – 500 to 1300
- Cable – over 1,800 miles
- Concrete – over 3 million cubic yards
- Electrical components – over 700,000
- Structural & reinforcing steel – ~500,000 tons

Increasing Demand for New Plants Creates Domestic Manufacturing Opportunity

In an analysis conducted in 2006, the Nuclear Energy Institute confirmed that there is adequate supply of key components for construction of the first four to eight new plants, but that more aggressive construction rates would challenge the supply chain. The constraints include reactor pressure vessels, steam generators, moisture separator reheaters, turbine generators, nuclear-grade pumps, nuclear-grade heat exchangers, nuclear grade valves, transformers, large-bore seamless piping, plant simulators, nuclear-grade batteries and nuclear-grade mechanical insulation. The study also determined that, of the hundreds of components that make up a nuclear plant, only two cannot currently be produced in the United States. These include ultra-heavy forgings and a type of specialized tubing.

The conclusion: The nuclear supply chain represents a major opportunity for American manufacturers to expand capacity to meet the needs of the growing world nuclear power market.

NEI is working with industry to expand the U.S. manufacturing base, and has seen a significant increase in the number of domestic nuclear suppliers. Today, U.S. manufacturers of components for new nuclear power plants and fuel cycle facilities are adding to design and engineering staff, expanding their capability to manufacture nuclear-grade components, and building new manufacturing facilities in preparation for new reactor construction in the U.S. and abroad.

Key Facts

- Over 15,000 new jobs created to-date.[5]
- Manufacturing and technical service jobs have been created in Virginia, North and South Carolina, Tennessee, Pennsylvania, Louisiana and Indiana.
- ASME Section III Nuclear Certificates (commonly called "N-stamps") held in the U.S. increased 22 percent – from 221 in January 2007 to 269 in May 2009.[6]
- 47 percent of all ASME Section III Nuclear Certificates are currently held in the U.S.[7]

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[4] "Manufacturing Capacity Assessment for New U.S. Nuclear Plants," NEI, April 2007

[5] See the NEI White Paper "New Nuclear Plants, An Engine for Job Creation, Economic Growth," for details.

[6] "BNCS Ex-Officio Report", ASME Committee on Nuclear Certification, June 17, 2009

[7] Ibid.

Operating Nuclear Power Plants Represent Major Economic Opportunity

In addition to the opportunities provided by new plants, existing nuclear power plants generate substantial economic value. In 2008, nuclear companies procured over $14.2 billion in materials, fuel and services from domestic suppliers.[8] Ongoing maintenance of existing nuclear power plants provides substantial economic benefit for American manufacturers.

Key Facts

- Nuclear procurement takes place in all 50 states (31 states have nuclear power plants). Leaders include:
    - – Maryland at over $1.9 billion
    - – Pennsylvania at over $1.8 billion, and
    - – Virginia at over $1.2 billion
- Average procurement per state: over $277 million
- Materials, fuel and services were procured from over 22,500 different vendors across the country[9]
- Over 30 million man-hours are worked by supplemental craft labor each year at the nation's 104 reactors, translating to over 14,000 Full-Time Equivalent jobs.[10]

Conclusion

Thanks to increasing world demand for new nuclear reactors, American companies have an unprecedented opportunity to expand the nuclear manufacturing base in the United States and open new international markets to domestic suppliers. American firms have the potential to expand production and repurpose existing infrastructure to re-emerge as world leaders in the nuclear industry. In the process, nuclear suppliers can contribute substantially to job creation, economic development and reduction of greenhouse gas emissions.

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[8] Procurement numbers are based on a Nuclear Energy Institute survey of member companies. The numbers include all data received by NEI through October 31, 2009. Procurement of nuclear services includes fees paid to regulatory agencies.

[9] The referenced number of domestic vendors includes all organizations from which the industry procured over $1,000 worth of materials, services, or fuel in 2008.

[10] Extrapolation of data from Associated Maintenance Contractors, October 2007, cited in Carol L. Berrigan, Testimony for the Record, U.S. Senate Committee on Energy and Natural Resources, November 6, 2007.

Estimated Full-Time Equivalent Employees per Gigawatt	Nuclear	Coal	NGCC	Onshore Wind
Operations [(a)]	550.0	200.0	65.0	125.0
Development and construction (man-years per gW) [(b)]	14,360.0	6,370.0	1,765.0	1,485.0
Development and construction period in years [(b)]	9.5	6.5	4.5	3.0
Avg. FTEs/year during construction period [(c)]	1,511.6	980.0	392.2	495.0

Notes

(a) *Task Force on America's Future Energy Jobs,* National Commission on Energy Policy, 2009, Averages of High and Low on Table 3, page 26. In addition to jobs associated with plant operation, nuclear power plants have a large number of maintenance jobs. NEI estimates maintenance jobs at approximately 150 Full-Time Equivalent Employees per gigawatt (based on 30 million contractor man-hours per year and 100.265 GW installed net summer capacity of existing nuclear fleet).

(b) *Task Force on America's Future Energy Jobs,* National Commission on Energy Policy, 2009, Appendix A: Bechtel Report on Design and Construction. Man-year numbers include salaried and hourly man-years.

(c) Straight-line average ignores the shaping associated with a peak construction period.

Appendix
Job Creation in the Nuclear Supply Chain: Individual Projects

Charlotte, N.C.
Toshiba will open its national project management and engineering center in Mecklenburg County, investing $2.8 million. The company sells the Advanced Boiling Water Reactor (ABWR) to be constructed in the United States and provides engineering, licensing, construction management, maintenance, and other services for nuclear power plants.

- *194 new jobs*

Charlotte, N.C.
Westinghouse is expanding its Charlotte-based workforce to focus on balance-of-plant engineering, and Boiling Water Reactor (BWR) instrumentation and control system development and project execution.

- *100 new jobs*

Newport News, Va.
AREVA and Northrop Grumman Shipbuilding are building a new manufacturing and engineering facility in Newport News, Va., to supply the growing American nuclear energy sector. The 300,000-square-foot facility represents an investment of more than $360 million, and will manufacture heavy components, such as reactor vessels, steam generators and pressurizers.

- *More than 500 skilled hourly and salaried jobs*

Lake Charles, La.
Shaw Modular Solutions is a 410,000-square-foot nuclear modularization facility at the Port of Lake Charles that assembles structural, piping, equipment, and other modules for new nuclear plants using the Westinghouse AP1000 technology. Operations began in mid-2009.

- *Between 700 and 1,400 workers at full capacity*

Fort Mill, S.C.
URS Corporation opened a new URS Nuclear Energy Center, the headquarters for the company's commercial nuclear energy engineering and construction business, which provides licensing, design, engineering, procurement and construction services for new nuclear power plants as well as for critical stages in the development of nuclear fuel cycle facilities.

- *More than 400 nuclear professionals are being hired over the next several years*

Wilmington, N.C.
GE Hitachi Nuclear Energy is investing $704 million to expand its 1,600-acre campus near Wilmington. The company is adding new manufacturing, training, simulation and testing facilities. The project also could include a commercial uranium-enrichment facility that would use a new laser process.

- *900 new jobs over the next five years*
- *Average wage of about $85,000 a year, more than double the New Hanover County average of $33,226*
- *GE Hitachi already employs more than 2,000 in New Hanover County.*

Turtle Creek, Pa.
Holtec manufactures dry fuel storage canisters and high-tech racks for electric utilities in the United States and around the world. Last year, Holtec added 90,000 square feet to its manufacturing division.

- *75 new jobs last year*
- *500 new hires in the next three to five years, including manufacturing and welding engineers, production workers and machinists*

Chattanooga, Tenn.
Alstom is building a new manufacturing facility in Chattanooga to manufacture steam turbines for fossil and nuclear plants, gas turbines, generators and related equipment. The project represents an investment of more than $200 million.

- *Approximately 350 jobs*

Mt. Vernon, Ind.
Lynchburg, Va.
Babcock & Wilcox Nuclear Power Generation Group, Inc., a subsidiary of The Babcock & Wilcox Co., provides nuclear power plant products, services and construction for utilities worldwide. Headquartered in Lynchburg, Va., the new company focuses on current and future needs of existing nuclear plants and provides capabilities to support construction of new plants. B&W NPG primary capabilities include design engineering, manufacturing, field service and construction.

- *300 skilled trade workers, primarily for the Mt. Vernon manufacturing facility*
- *100 engineers, primarily at the Lynchburg facility, for field service and new reactor projects*

Cheswick, Pa.
Curtiss Wright (Curtiss Wright Flow Control Corp.) completed construction in mid-2009 on a $62 million, state-of-the-art, multipurpose Large Manufacturing Complex in Cheswick, Pa. The nine-story, 48,000-square-foot facility is being used to build commercial nuclear reactor coolant pumps as well as support the production and testing of other new large products.

- *80 jobs from engineering positions to skilled machinists and assemblers*
- *Curtiss Wright currently employs approximately 700 in Cheswick*

Cranberry Woods, Pa.
Westinghouse is nearing completion of a new facility in Cranberry Woods, Pa., that will house the company's Nuclear Power Plant Business unit. New employees are expected to begin working at the facility in 2009. Employees currently located at existing facilities in Monroeville and Churchill will follow in a second-phase move, with all employees expected to be in the new facility by year-end 2010.

- *At least 1,000 local workers during the next five years*

Job Creation: Totals by Major Suppliers

AREVA

- *Has hired about 350 people this year throughout its locations in the U.S.*
- *Anticipates adding 200 to 250 more employees in 2009*

Westinghouse

- *Has hired 3,000 people in the past three years*
- *Expects to add 400 to 500 per year for the foreseeable future to meet expected demand from new nuclear plant construction*

Shaw Group

- *Has hired an additional 5,000 professional and craft workers over the last three years because of global growth in its power, energy and chemicals, and fabrication and manufacturing divisions*
- *Opportunities in the power division include engineering and design for next-generation nuclear plants*

Job Creation at Fuel Cycle Facilities

Eunice, N.M.

LES began construction on its uranium enrichment facility in 2006. It is scheduled to begin full commercial operations in 2009. Total construction cost is approximately $3 billion.

- *1,100 construction jobs*
- *244 operations jobs have already been created and an additional 60 are expected to be added when the facility is fully operational*

Piketon, Ohio[11]

USEC began construction on the American Centrifuge Plant in 2007 and expects to begin commercial operations in 2010 and continue to expand capacity through 2012. The plant is expected to cost $3.5 billion.

- *Approximately 1,000 construction jobs*
- *420 jobs when commercial operation begins*
- *6,300 total direct and indirect jobs being created at the site and at suppliers and manufacturers across the country*

Bonneville County, Idaho[11]

AREVA expects to begin construction on its uranium enrichment facility in 2011. Plant design and construction will take 8 to 10 years, at a cost of $2 billion.

- *1,000 to 1,250 construction jobs, as well as an additional 450 to 500 indirect and induced jobs*
- *Operations and management of the plant will create 250 to 400 jobs, as well as an additional 400 to 600 indirect and induced jobs*

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[11] Construction of these projects depends on loan guarantees from the U.S. Department of Energy.

Statement of Abraham Breehey
Director of Legislative Affairs, International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers

United States Senate, Committee on Finance

Climate Change Legislation: Considerations for Future Jobs

November 10, 2009

Chairman Baucus, Senator Grassley, and Members of the Committee, my name is Abraham Breehey and I am the Director of Legislative Affairs for the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers. On behalf of the members of my union and our International President Newton B. Jones, thank you very much for the opportunity to testify today.

The members of the Boilermakers Union will be among those workers on the front lines of our nation's transition to a clean energy, low-carbon economy. While we recognize that such a transition will not be easy or without cost, it is essential that the United States begin the important work of reducing emissions that cause climate change. Further, if Congress moves forward with a comprehensive cap and trade program to reduce emissions, the demand for climate solutions will create job opportunities across the economy. We can put American ingenuity and skills to work reducing emissions. With the right market signals, we can turn the jobs union members do everyday into the environmental solutions our nation needs to meet this enormous challenge.

Establishing Environmental and Economic Certainty

The lack of a clear, comprehensive policy on global warming and the uncertainty associated with the future regulation of greenhouse gases is delaying the creation of job opportunities our nation needs. The longer we wait to provide investors, regulated entities, and entrepreneurs the market signals that will reward innovation to reduce emissions, the more our nation's competitors get a head start on the clean energy race.

The Senate must demonstrate bipartisan leadership and develop the kind of policies that will provide certainty, control costs, and encourage job-creating investments in clean energy technology. Without clear policies regarding performance standards and emissions limits – including appropriate incentives for the installation of new technology – we could miss an opportunity to make the United States the leader in advanced coal-technology development, an undertaking that is essential to meeting any significant global effort to reduce emissions.

In addition, our union greatly prefers effective, balanced climate legislation to the regulation of greenhouse gases by the U.S. Environmental Protection Agency under the Clean Air Act. We believe legislation would more effectively balance regional, environmental, and economic concerns, while providing the necessary incentives for the technology deployment that will create jobs.

Low-Carbon Coal Jobs

The development and deployment of carbon capture and storage (CCS) technology at power plants and industrial facilities is among the technological breakthroughs that could not only reduce our nation's carbon footprint, but also create significant job opportunities for American workers. The level of investment, both federal and private, necessary to ensure the widespread commercialization of CCS is highly unlikely in the absence of comprehensive clean energy legislation.

Climate legislation, such as S. 1733, the Clean Energy Jobs and American Power Act, must rightfully recognizes that the widespread deployment of carbon capture and storage technology is essential to our nation's energy future. Economic growth in the U.S. has been fueled by affordable, reliable energy from coal. Countless jobs in communities across the country are dependant upon our ability to continue the use of coal for power generation. However, the Boilermakers recognize the adverse environmental consequences associated with business as usual. Just as our union and other crafts provided the man-power necessary to assemble and deploy the technology to reduce particulate emissions, NO_x, and SO_2, we are confident that technology will enable continued responsible use of coal with CCS.

We appreciate Chairman Baucus, Senator Carper and the other Senators involved for their work in the development of the provisions of S. 1733 designed to encourage the early and widespread deployment of CCS technology at coal plants, including new generating capacity and retrofit applications. The deployment of this technology will not only have tremendous environmental benefits, but also will have employment and economic benefits for workers in the Boilermakers Union, other building and construction trades, and other industries engaged in CCS development.

Our union strongly supports a robust bonus allowance program, such as that established under Section 780 of S. 1733, to provide financial incentives and assistance for the commercial deployment of carbon capture technology. Establishing the advance payment of bonus allowances will provide the financial incentives necessary for utilities to undertake these capital intensive, yet vital projects. Advanced payments of bonus allowances will also assist energy developers to secure the financing necessary for these essential energy infrastructure projects to move forward.

Section 780 will encourage CCS applications at both new and existing units, and provides additional incentives for early adopters and projects achieving the highest rate of capture and storage. Also, expanding the availability of fixed payments for CCS to a greater number of projects increases both its environmental and employment benefits. Providing these bonus allowances to cover the entire marginal increase in costs between an advanced coal plant with CCS and a standard, supercritical pulverized coal plant should support widespread adoption without a significant increased cost to ratepayers.

The construction of coal based generation facilities and CCS technology is tremendously labor intensive, requiring the skills from a wide range of crafts in the building and construction trades. CCS projects will be long-lasting job opportunities for boilermakers, pipefitters, laborers, millwrights, and other workers who are engaged in construction of this technology.

The Boilermakers and other unions whose members rely on employment opportunities at coal-fired power generation facilities recently commissioned a study conducted by BBC Research and Consulting to illustrate the potential jobs and other economic benefits of advanced coal-fired electric generation using CCS technologies. A copy of the full results of that study is included in my written testimony as Attachment 1.

The study found that the economic benefits from construction of a single 540 MW pulverized coal plant with CCS include employment benefits during the construction phase totaling nearly 14,000 job-years. The benefits associated with construction of an advanced coal unit with CCS reach 36,000 total job-years, when indirect and induced employment impacts are included. Similarly, the study found that the job creation potential of just the CCS related employment from deploying a 20 GW fleet of advanced coal facilities is tremendously promising. In the construction sector alone, 20 GW of capacity would support 500,000 direct job-years of employment.

The National Commission on Energy Policy recently issued a report from its "Task Force on America's Future Energy Jobs." The Task Force included representatives of academic, industry, environmental, and labor organizations, including the Boilermakers, the AFL-CIO, the United Mineworkers of America, and the International Brotherhood of Electrical Workers. The Task Force relied in part on job data provided by Bechtel Power Corporation, a major international power engineering and construction firm, to estimate the labor needs associated with construction of new clean energy generation infrastructure.

The workforce estimates for alternative generation technologies indicates that the coal-based CCS and nuclear power generation options have the highest job creation potential, relative to other supply options, such as natural gas.

Person-Years per GW of New Generation Capacity,
Development and Construction Phases

Technology	Salaried Workforce	Hourly Workforce	Total Person-Years
Nuclear	4,785	9,575	14,360
Supercritical PC w/CCS	2,140	8,435	10,575
IGCC coal w/CCS	2,795	8,145	10,940
Natural Gas Com. Cycle	485	1,270	1,765
Onshore wind	305	1,180	1,485

Source: National Commission on Energy Policy, Task Force Report on America's Future Energy Jobs (2009).

These figures are based on 1 GW of electric power capacity, equivalent to one 1,000 MW coal or nuclear facility, or 250 4 MW wind turbines. Based on Bechtel's analysis, the development and construction phase of deploying a normalized 1 GW of power generated by an Integrated Gasification Combined Cycle coal plant equipped with CCS would employ 2,795 salaried workers and an hourly workforce of over 8,000 skilled workers. Comparatively, 1 GW onshore wind generation would require a salaried workforce of 305 and 1,180 hourly workers.

In sum, it is clear that Carbon Capture and Storage development and deployment represents a tremendous employment opportunity for the members of my union, and other workers. Early deployment and bonus allowance programs for CCS included in comprehensive climate legislation will be a tremendous driver for job creation in a low-carbon economy.

Commitment to High Quality Employment

Of course, it is not just jobs or even "green" jobs that our union is interested in. Our members are interested in high-quality jobs, that provide the kind of wages and benefits that can enable a clear path to the middle-class and support a family. However, good jobs will not necessarily be created by any climate change legislation without the inclusion of fair, enforceable labor standards. The application of wage standards to the deployment of energy infrastructure will ensure the benefits of federal investment in clean energy are extended not just to developers and businesses, but also to the workers whose skills are essential to building a clean energy economy.

Our union believes climate legislation must not only encourage a commitment to environmental protection, but also to fair and decent labor standards. For example, under the Clean Energy Jobs and American Power Act of 2009, workers employed on projects assisted or incentivized through allowance allocations or other means will be assured wage rates no less than those prevailing in their local community through the consistent application of the Davis-Bacon Act.

This law protects both communities and employers by preventing the undercutting of local standards, and ensuring that federally assisted projects neither drive-down nor artificially inflate wages. This law protects workers in both big cities and rural areas, and protects union and non-union workers alike. In short, Davis-Bacon will ensure that "green jobs" are also good jobs.

Workers employed on clean energy infrastructure projects should be well trained and highly experienced – all construction project characteristics encouraged by the Davis-Bacon Act. Numerous studies show that projects built under prevailing wage provisions are more likely to be completed on time, within budget and with fewer future repair costs. Ensuring these high standards for both workers and contractors will be particularly important when applied to new, highly technical construction projects, such as CCS technology.

Neither American taxpayers, facility owners, nor the environment can afford anything less than the high-standards ensured by the application of prevailing wages. We strongly urge the Senate to include the application of Davis-Bacon prevailing wage standards to the programs that will be a part of any comprehensive climate change and energy legislation.

Avoiding Adverse Employment Impacts and Maximizing Job-Creation Potential

While the adoption of comprehensive climate legislation that establishes a declining cap on carbon will lead to the creation of new employment opportunities in low-carbon industries, Congress must also act to mitigate adverse employment impacts. Among the most significant concerns of our union regarding efforts to regulate carbon emissions is its impact on energy intensive, trade exposed industries, particularly if major trading partners fail to take similar responsible action.

While the Boilermakers Union directly represents workers in the cement industry, other energy intensive industries – such as steel – provide employment opportunities for our construction members. These industries are the backbone of American manufacturing, and a source of high-wage employment for millions of workers and their families. It is essential that comprehensive climate legislation include adequate provisions to prevent employment losses in these industries.

Climate policy must not undermine the competitiveness of U.S. manufacturers in the global marketplace. Industries such as steel, cement, and chemicals are more sensitive to energy cost increases than other sectors of the economy. An adequate allocation of allowances to an output-based rebate program for energy-intensive, trade exposed industries will help ensure that the migration of jobs and pollution does not undermine the environmental and economic development goals of domestic action. In addition, climate policy should not incentivize fuel switching for power generation from coal to natural gas, a fuel that also serves as a raw material input in many manufacturing processes.

Further, while the allocation of allowances to energy-intensive industries is essential, it is not sufficient to address all of the concerns related to job losses in the manufacturing sector. At its core, global warming is the most negative consequence of misguided trade and globalization policies that fail to account for the negative environmental impacts of shipping, for example, a container vessel full of cement from an inefficient facility in Thailand to San Francisco for use on U.S. highways. In addition, simply providing an allocation of allowances to domestic industries would be a missed opportunity to encourage – using both "carrots" and "sticks" – responsible action from major emitters in those rapidly developing countries that are a major source of global emissions.

It is critically important that the Senate include a strong, yet fair border measure to prevent so-called carbon leakage. Energy-intensive imported goods from countries that fail to take action comparable to any domestic emission reduction program should be required to purchase and submit a type of "emissions allowance" that accounts for the carbon content and price of the imported good. Such provisions should be triggered shortly after domestic industries are subject to the requirements of a domestic program. We believe this approach would provide significant leverage for U.S. negotiators in the context of global climate change negotiations, while remaining consistent with our existing trade obligations.

In addition, it was deeply disconcerting to learn this week that federal clean energy investments made through the American Recovery and Reinvestment Act have been used for projects that generate jobs in China, not the United States. As was widely reported, a Texas wind farm project that will rely exclusively on wind turbines manufactured in China has applied for financial assistance from the U.S. Department of Energy. If the United States fails to include appropriate domestic content requirements on projects financed or incentivized by a domestic climate program, we will have failed to capitalize on what is likely our last best opportunity to revitalize American manufacturing.

It will be American workers and American taxpayers making sacrifices to reduce domestic carbon emissions. It must also be American workers who benefit from the job creation opportunities these climate solutions create. There are new opportunities for American workers not just in the final construction jobs, but all throughout the supply chains of clean energy technology. For example, members of my union in Indiana who produce gear blanks for heavy equipment could easily do the same work producing gear blanks used in wind turbines. But the demand for U.S. parts and components will never materialize if American workers are undercut by Chinese workers that are denied the most basic labor rights. Projects that receive allowance allocations or other assistance through U.S. climate legislation must be required to incorporate domestic content if the full job creation potential of the clean energy economy is to be realized.

On behalf of my union's members in the Boilermaker's Cement, Lime, Gypsum and Allied Workers Division, we have some suggestions regarding provisions specific to cement manufacturing. An additional challenge for cement occurs because the process of calcining limestone into cement releases carbon dioxide regardless of the energy source it uses. We suggest that this variety of process emissions – emissions that essentially cannot be reduced – not be included under the cap. In addition, we ask that energy-intensity be properly calculated, reflecting actual clinker production from U.S. cement kilns. We must ensure the production of this strategic commodity not shift overseas. The result of such a shift would be to harm domestic employment, and to increase emissions as less efficient foreign kilns replace more modern domestic ones.

Our union believes that the allocation of allowances to electricity consumers through local distribution companies (LDCs) is the most effective approach for preventing increased utility costs for families, and avoiding adverse employment impacts. While there are certainly a number of worthy options for allocating emissions allowances, we suggest the allocations to LDCs for electricity consumer relief be consistent with the level of emissions from the power sector in the early years of the program. The allocation of allowances to electric utility "wires" companies avoids the risk of windfall profits, will reduce the risk of fuel switching from coal to natural gas, and helps offset compliance costs.

Further, as was mentioned early in my testimony, a priority is to provide the greatest level of regulatory certainty possible when it comes to the permitting of new power generation facilities. One key objective of federal climate change legislation must be to establish a new framework for reducing economy-wide greenhouse emissions. In Waxman-Markey, this framework relies on a cap-and-trade program that allows companies to achieve emissions reductions in the most efficient, cost-effective manner possible. To do so, the new cap-and-trade program must replace existing command-and-control programs

The House legislation appropriately provided exemptions from permitting and other air regulatory requirements established for conventional air pollutants under the Clean Air Act. These exemptions were carefully tailored to apply only to greenhouse gas emissions from sources that would be regulated under the new cap-and-trade regime. The goal of a cap-and-trade program is not just to reduce emissions, but also to do so in the most efficient and cost-effective manner. Failure to address these issues could undermine that goal and blunt the beneficial employment opportunities available through emissions reductions from the power sector.

In addition, we believe that an effective cost containment provision is essential to not only limiting the overall economic impact of the program, but minimizing allowance price volatility and discouraging market manipulation. Carbon allowance price certainty is another mechanism that would enable predictable investment planning that is important to job creation. A price collar that includes both minimum and maximum allowance prices would not only encourage job creation, but minimize any adverse employment should clean energy technology deployment not proceed at the pace hoped for or expected.

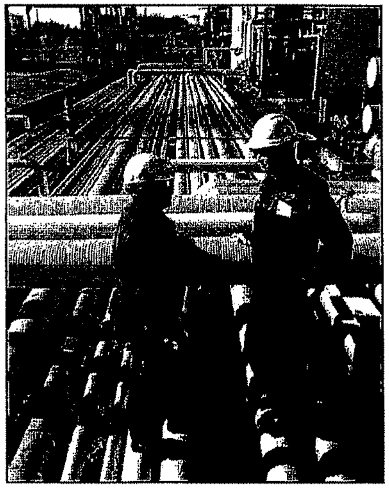
Finally, we have some concern regarding the stringency of the emissions reductions targets in the early years of the cap and trade program. Should the development of CCS technology not proceed quickly enough, these early caps may encourage some plants that could otherwise be retrofitted to shut down or switch to natural gas. As I mentioned, the job creation opportunities available from CCS far exceed those from new construction of a natural gas combined cycle plant. Therefore, we encourage the Senate to consider an emissions reduction target in 2020 of 14% below 2005 levels, consistent with the program called for in President Obama's budget proposal.

Again, I thank the Committee for the important work you are doing here today, and the opportunity to express my views.

Attachment 1

Employment and Other Economic Benefits from Advanced Coal Electric Generation with Carbon Capture and Storage

(Preliminary Results)



Prepared for:

- **Industrial Union Council, AFL-CIO**
- **International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers, and Helpers**
- **International Brotherhood of Electrical Workers**
- **United Mine Workers of America**
- **American Coalition for Clean Coal Electricity**

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BBC
RESEARCH &
CONSULTING
Douglas Jeavons, Managing Director
3773 Cherry Creek N. Drive, Suite 850
Denver, Colorado 80209
www.bbcresearch.com
-and-
James Marchetti
Edward Cichanowicz
Michael Hein

Introduction

- The development and broad deployment of CCS technologies can be a key part of a national strategy to reduce CO_2 emissions and address climate change concerns.
- Initiatives to reduce greenhouse gas emissions are likely to stimulate the deployment of new, advanced coal generation facilities with carbon capture and storage (CCS), provided CCS technology development is successful and timely.
- In addition to environmental benefits, this study also shows that the development and deployment of CCS technologies can serve as an economic stimulus.
- This study estimates the capital, operating and maintenance costs (O&M), jobs and other economic benefits associated with the deployment of advanced coal generation with CCS.

Purpose and Caveats

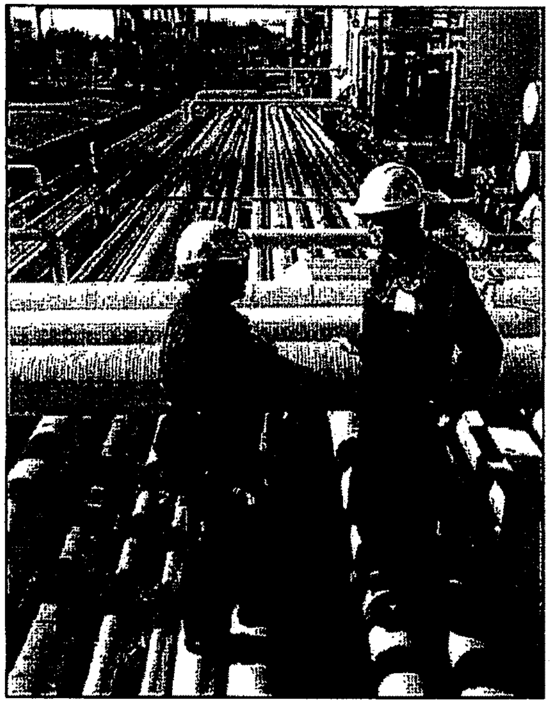
- The purpose of this study is to illustrate the potential job and other economic benefits from the deployment of advanced coal-fueled electric generation using carbon capture and storage technologies ("CCS-only benefits").

- ***The study does not take into account adverse economic impacts that may result from proposals to reduce greenhouse gas emissions.***

- Numerous analyses by EIA, DOE, and NGO's have shown that complying with emission reduction targets is likely to have adverse economic impacts on the coal and electric generation sectors, along with other industries and sectors.

- Study results are presented at the national level to illustrate the potential magnitude of job, GDP and income benefits associated with the construction and operation of these new advanced coal-fueled electric generation technologies.

- ***This study is not intended to imply support for any policy position regarding climate change legislation, or to endorse assumptions regarding the level of future deployment of Advanced Coal facilities with CCS.***



Part 1:
Background and Study Approach

Overview of Study Approach

- The study team:
  - Analyzed recent studies from the U.S. Department of Energy's National Energy Technology Laboratory (NETL) and the Electric Power Research Institute (EPRI) to estimate the costs and operating characteristics of typical Advanced Coal CCS facilities.
  - Estimated the infrastructure and operating requirements for carbon capture and storage by examining regional projections of future Advanced Coal CCS capacity from EPA analyses of climate change proposals to determine possible plant locations relative to potential CO_2 storage locations.
  - Estimated the coal mining and fuel transportation requirements, and likely sources, for new Advanced Coal CCS facilities based on the potential regional distribution of Advanced Coal CCS facilities from the EPA analyses.
- Construction and operating expenditures were incorporated into the IMPLAN input-output model to estimate the national effects of construction and ongoing operations on economic output, value-added, jobs and labor earnings.
- The flow chart on the following page illustrates the study approach.

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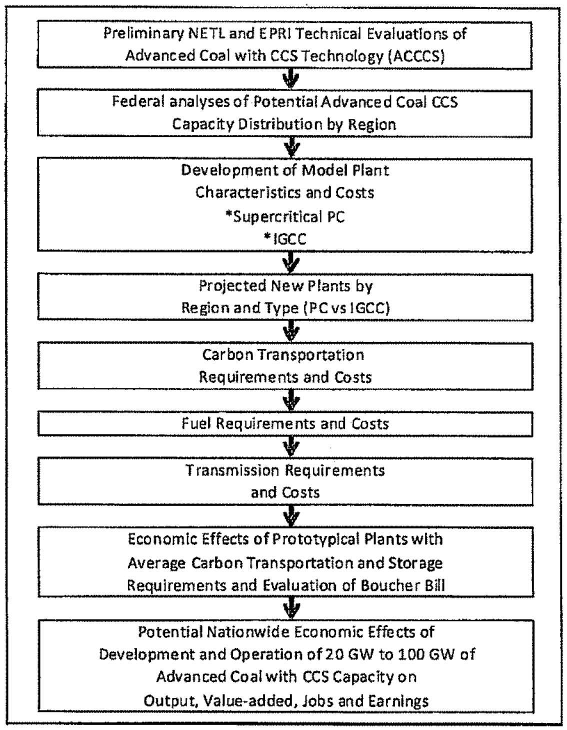
Study Approach



Preliminary NETL and EPRI Technical Evaluations of Advanced Coal with CCS Technology (ACCCS)

Federal analyses of Potential Advanced Coal CCS Capacity Distribution by Region

Development of Model Plant Characteristics and Costs
*Supercritical PC
*IGCC

Projected New Plants by Region and Type (PC vs IGCC)

Carbon Transportation Requirements and Costs

Fuel Requirements and Costs

Transmission Requirements and Costs

Economic Effects of Prototypical Plants with Average Carbon Transportation and Storage Requirements and Evaluation of Boucher Bill

Potential Nationwide Economic Effects of Development and Operation of 20 GW to 100 GW of Advanced Coal with CCS Capacity on Output, Value-added, Jobs and Earnings

Advanced Coal Plant Technology

- Based on recent NETL and EPRI research, this study focuses on two technologies: Advanced Supercritical Pulverized Coal (PC) with CCS and Integrated Gasification Combined Cycle (IGCC) with CCS.
  - ➢ PC – Pulverized coal is used in a boiler designed to deliver "supercritical" steam conditions, generating power with high plant generating efficiency. Combustion products, after removal of nitrogen oxides, particulate matter, mercury and sulfur dioxide, are processed in a post-combustion scrubber to remove approximately 90% of the CO_2.
  - ➢ IGCC – Coal is partially oxidized in oxygen, generating a synthetic gas (syngas). Steam is injected into the syngas to "shift" most of the chemical energy in the CO to H_2, producing mostly CO_2 and H_2. After cooling, the CO_2, mercury and SO_2 are removed, leaving H_2 to fuel a combined cycle generating plant, and the byproducts include sulfur compounds and highly concentrated CO_2. As envisioned for this study, IGCC designs remove approximately 90% of the CO_2.

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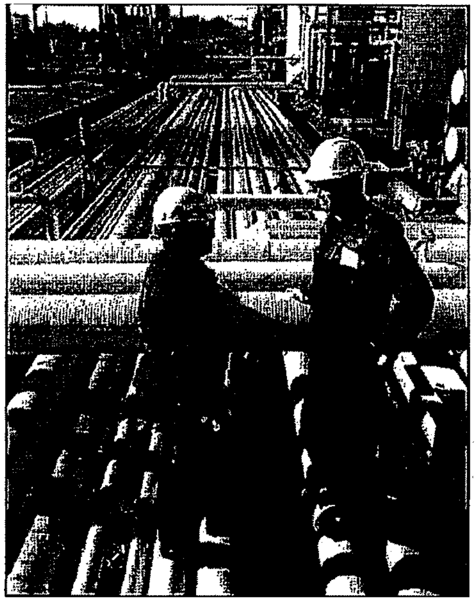
Terminology

- **Direct economic effects** – Output, jobs and other economic measures at electric generating plants, sites manufacturing the equipment used in the plants, coal mines, carbon transportation and storage facilities and for firms transporting coal to plants.
- **Indirect economic effects** – Output, jobs and other economic activity stimulated by purchases of goods and services by directly affected industries from other firms. Purchases of equipment or consulting services by coal mines would be examples of indirect effects.
- **Induced economic effects** – Output, jobs and other economic activity stimulated by purchases by employees of directly and indirectly affected businesses. Purchases of groceries and home rental expenditures would be examples of induced effects.
- **Multiplier effects** – Sum of indirect and induced economic effects.
- **Output** – Generally equivalent to sales.
- **Value-added** – Sales net of the costs of inputs. When summed across all industries, generally equivalent to gross domestic product (GDP).
- **Job-year** – One job for a one-year period.

Notes

- Monetary economic effects (e.g., output, value-added and labor income) are reported in year 2007 dollars.
- Expenditures for plant construction, operations and maintenance were estimated and are reported in year 2007 dollars.
- All other capital and operating expenditures (e.g., coal costs, pipeline construction costs) were estimated and are reported in year 2006 dollars. The IMPLAN model was used to update these costs to year 2007 dollars prior to estimating economic effects.



Part 2:

Expenditures, Jobs and Other Economic Benefits from an Individual Advanced Coal Plant with CCS

Summary of Benefits from an Individual Advanced Coal Unit with CCS

- Advanced coal units with CCS are assumed to have net generating capacities of 520 megawatts (MW) for IGCC and 540 MW for PC.

- Construction expenditures for either a Supercritical PC unit with CCS or an IGCC unit with CCS are approximately $2.0 to $2.1 billion.

- Annual O&M expenditures are $137 million for an IGCC unit with CCS and $127 million for a Supercritical PC unit.

- Construction of either type of facility is expected to support about 13,000 to 14,000 direct job-years and about 36,000 to 38,000 total job-years (including indirect and induced effects throughout the economy).

- Ongoing annual employment from O&M activity at an individual unit, including coal purchases and transportation, is projected at between 250 and 270 direct jobs. Including multiplier effects, between 1,200 and 1,300 total jobs would be supported throughout the economy.

Construction and Operating Expenditures for an Advanced Coal Facility with CCS

	Advanced Coal Facility Type	
Expenditure Category	**Supercritical Puverized Coal**	**Integrated Gasification Combined Cycle**
Net Generating Capacity	540 MW	520 MW
Capital Costs for Construction ($ Millions)		
Plant	$2,090	$1,976
Transmission Upgrades	$32	$32
Pipelines and Compressors	$21	$21
Carbon Storage Site	$2	$2
Total Construction Costs	$2,145	$2,031
Annual Operating & Maintenance Costs ($ Millions)		
Plant	$50.0	$61.8
Coal (minemouth cost)	$29.3	$54.9
Coal (transportation)	$39.3	$12.6
Pipeline and Compressor Stations	$7.4	$7.4
Storage Site	$0.6	$0.6
Total Annual O&M Costs	$126.6	$137.2

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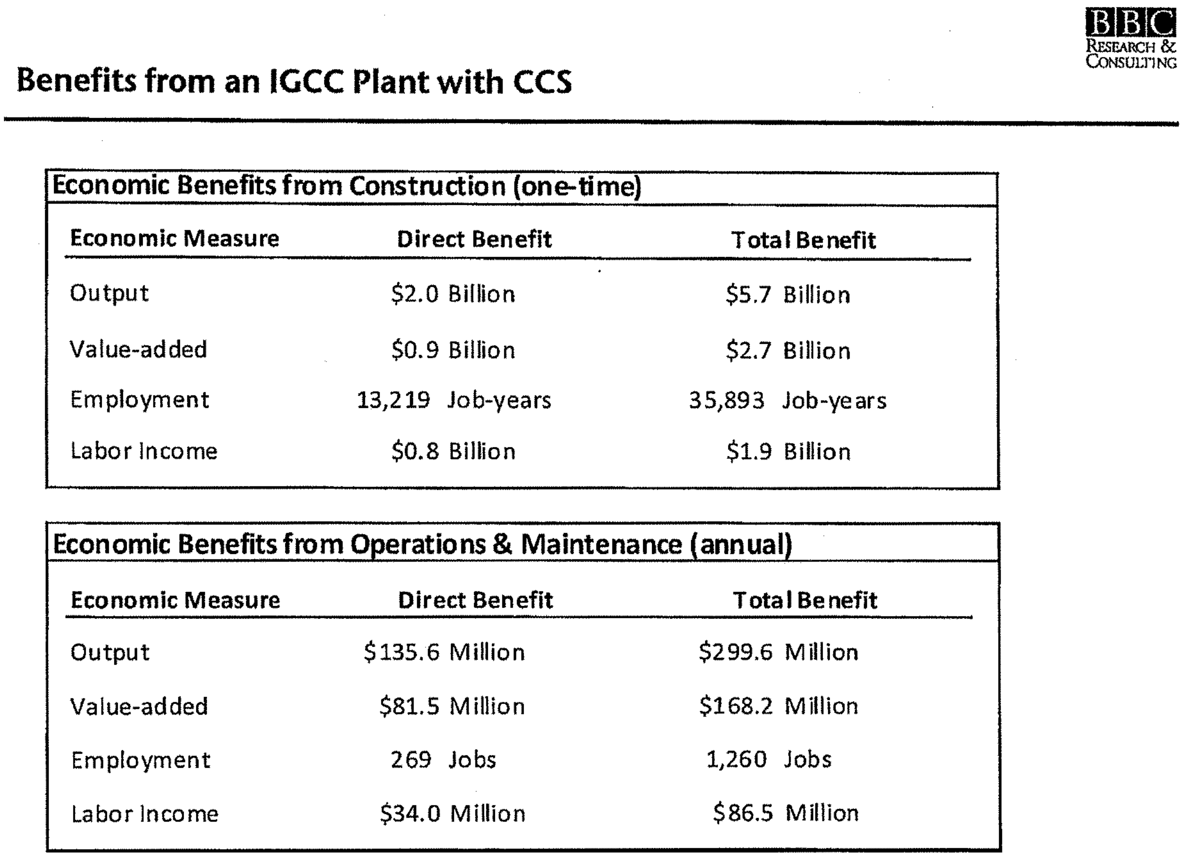
Benefits from a Supercritical PC Plant with CCS

Economic Benefits from Construction (one-time)

Economic Measure	Direct Benefit	Total Benefit
Output	$2.1 Billion	$6.0 Billion
Value-added	$0.9 Billion	$2.9 Billion
Employment	13,952 Job-years	37,878 Job-years
Labor Income	$0.8 Billion	$2.0 Billion

Economic Benefits from Operations & Maintenance (annual)

Economic Measure	Direct Benefit	Total Benefit
Output	$126.6 Million	$285.4 Million
Value-added	$73.6 Million	$157.0 Million
Employment	251 Jobs	1,225 Jobs
Labor Income	$30.7 Million	$81.9 Million



Benefits from an IGCC Plant with CCS

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Economic Benefits from Construction (one-time)		
Economic Measure	**Direct Benefit**	**Total Benefit**
Output	$2.0 Billion	$5.7 Billion
Value-added	$0.9 Billion	$2.7 Billion
Employment	13,219 Job-years	35,893 Job-years
Labor Income	$0.8 Billion	$1.9 Billion

Economic Benefits from Operations & Maintenance (annual)		
Economic Measure	**Direct Benefit**	**Total Benefit**
Output	$135.6 Million	$299.6 Million
Value-added	$81.5 Million	$168.2 Million
Employment	269 Jobs	1,260 Jobs
Labor Income	$34.0 Million	$86.5 Million

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Benefits from Rep. Boucher's Bill (HR 6258)

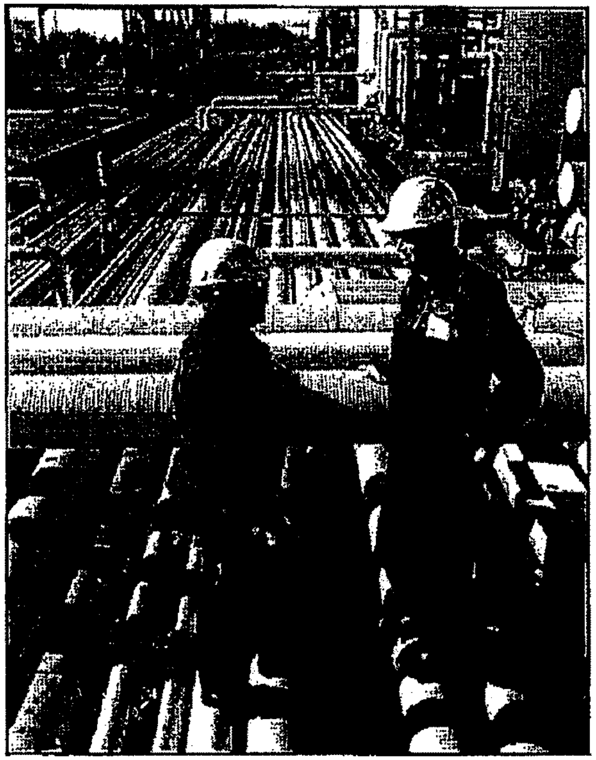
- HR 6258, the "Early Carbon Capture and Storage Commercial Demonstration Act of 2008," is designed to advance the commercial deployment of Advanced Coal CCS facilities.

- If the proposed $10 billion in funding under HR 6258 for early commercial deployment of CCS technology leads to development and operation of six (6) plants:

  - Including multiplier effects, construction would stimulate between $33 billion and $36 billion in total economic output, about 225,000 total job-years of employment, and about $12 billon in labor income.

  - Ongoing operations and maintenance would support about 7,500 permanent jobs throughout the economy and about $500 million in annual labor income.

  - Economic benefits would occur in virtually all sectors of the economy. The largest number of jobs from new facility development would be in the construction, manufacturing and professional services sectors. The largest number of jobs supported by ongoing operations would be in mining, transportation and utilities.



Part 3:
Benefits From Future Deployment of a Fleet of Advanced Coal CCS Facilities

Potential Extent of Advanced Coal CCS Development

- This study illustrates the potential magnitude of CCS-only benefits under three alternative levels of deployment: 20 gigawatts (GW), 65 GW and 100 GW. The study assumes an equal mix of PC plants with CCS and IGCC plants with CCS.

- The study is not intended to imply any policy endorsement of these levels of deployment; rather, the study simply assumes these levels for purposes of analysis. Moreover, these results do not consider any potential economic impacts of emission reduction requirements.

- 20 GW of advanced capacity would require deployment of about 38 plants, based on the generating capacities for typical plants (540 MW for PC and 520 MW for IGCC). 65 GW of advanced capacity would require development of approximately 122 plants, and 100 GW of advanced capacity would require approximately 188 plants.

- The following pages summarize projected expenditures for construction and O&M for Advanced Coal facilities with CCS under this assumed range of future deployment, as well as projected nationwide economic benefits from construction and O&M.

Summary of National Economic Benefits from 20-100 GW of Advanced Coal Facilities with CCS

- Construction expenditures for this range of capacity of Advanced Coal facilities with CCS are projected at $79 billion to $393 billion.

- Annual O&M expenditures, including coal purchase and transportation, are projected at $5 billion to $25 billion for this range of future Advanced Coal with CCS capacity.

- Construction of 20 GW of capacity would require about 0.5 million direct job-years of labor and support about 1.4 million job-years of labor throughout the economy.

- Development of 100 GW of capacity would require about 2.6 million direct job-years for construction and support about 6.9 million total job-years of labor throughout the economy.

- Annual O&M for this range of Advanced Coal with CCS capacity would directly support between 10,000 jobs and 49,000 jobs. Including indirect and induced effects (sometimes referred to as "multiplier effects"), deployment in this range would create between 48,000 and 235,000 permanent jobs throughout the economy.

- Economic benefits would be widely distributed across sectors. The largest benefits from construction would be in the construction, manufacturing and professional services sectors. Mining, utilities and transportation would be among the sectors most benefited by ongoing operations and maintenance activities.

Nationwide Expenditures for Construction of 20-100 GW of Advanced Coal Facilities with CCS

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	20 GW	65 GW	100 GW
New Supercritical PC Plants (540 MW)	19 plants	61 plants	94 plants
New IGCC Plants (520 MW)	19 plants	61 plants	94 plants
Total Capital Cost for New Plants	$78.5 Billion	$251.9 Billion	$388.2 Billion
Total Capital Cost for Transportation & Storage Infrastructure	$0.9 Billion	$2.8 Billion	$4.4 Billion
Total Overall Capital Investment	$79.4 Billion	$254.8 Billion	$392.6 Billion

Nationwide Expenditures for Annual O&M for 20-100 GW of Advanced Coal Facilities with CCS

	20 GW	65 GW	100 GW
New Supercritical PC Plants (540 MW)	19 plants	61 plants	94 plants
New IGCC Plants (520 MW)	19 plants	61 plants	94 plants
Plant Fixed and Variable O&M	$2.1 Billion	$6.8 Billion	$10.5 Billion
Coal Costs (minemouth)	$1.6 Billion	$5.1 Billion	$7.9 Billion
Coal Transportation Costs	$1.0 Billion	$3.2 Billion	$4.9 Billion
Total Fuel Costs	$2.6 Billion	$8.3 Billion	$12.8 Billion
Power and O&M for Transportation & Storage	$0.3 Billion	$1.0 Billion	$1.5 Billion
Total Annual Costs	$5.0 Billion	$16.0 Billion	$24.7 Billion

Senate Finance Committee
Climate Change Legislation: Considerations for Future Jobs

November 10, 2009

Responses to Questions for Mr. Abraham Breehey – Director of Legislative Affairs, International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers

Questions from Senator Baucus

1. I share your view that climate legislation should maintain the competitiveness of U.S. industry and provide strong incentives for other countries to implement commitments to reduce their carbon emissions. I have been working on a proposal that would establish a two-tiered carbon reduction target. The target would start at one level but require deeper reductions if other major emitters make and implement carbon reduction commitments. Would a two-tiered approach soften the impact of the legislation on employment in your industry? Would the Boilermakers support this type of approach?

Our union believes we need thoughtful, creative solutions to both the substantive and political barriers to the enactment of effective climate change legislation that reduces emissions without the migration of jobs and pollution to countries that fail to act. The approach you suggest would, in our view, be a promising one. A two-tiered target predicated on action by other major emitters would certainly provide some protection to workers in energy-intensive, trade exposed industries. However, we must ensure that the actions or reduction pledges of other major emitters are measurable, reportable, and verifiable before committing our nation to more aggressive near term reduction targets. While I am hesitant to commit my union's support to such an approach without some additional information regarding the level of reductions proposed in each tier and the conditions for accelerating domestic emissions reductions, I certainly welcome the opportunity of working with your office to advance such an approach.

2. Your testimony mentions that members of your union can just as easily produce gears for heavy equipment as they can produce gears for wind turbines. To what extent are jobs in the energy sector interchangeable? To what extent will new jobs in low-carbon industries offset any decrease in energy-intensive and trade-exposed industries?

I have no reason to believe the example of our union's Blacksmith local that I was referring to in my testimony is a unique example. From manufacturing to construction, many of the skills required to build the clean energy are the same skills union members use today. This is particularly true for workers in the skilled building and construction trades.

We strongly believe the extent to which new jobs offset negative employment impacts will greatly depend on the policy design of a cap and trade climate change bill. For example, an allocation of allowances to the utility sector based on historical emissions to be passed on to consumers through local distribution companies will help prevent job losses resulting from rising energy prices, and appropriate provisions to protect energy intensive trade exposed industries should minimize losses in the manufacturing sector.

Further, the percentage of allowance value allocated to programs that spur job growth, such as investment in energy efficiency, new technology for the power sector, and transportation improvements, will determine the success of a cap and trade program in creating jobs. The unions of the Building and Construction Trades strongly support provisions in climate legislation that represent aggressive federal investment in various kinds of infrastructure that will drive job creation.

However, the new jobs that will be created may not be in the same geographic location as the jobs that could be lost. That is why it is vital that legislation also include provisions to ensure that workers who are negatively impacted receive the assistance and training to successfully transfer their skills to new emerging clean energy industries.

3. Several recent news reports indicate that China is making great strides in the development and manufacture of clean-energy technology. An August 2009 Christian Science Monitor article notes that Chinese factories already make a third of the world's solar cells – six times more than the U.S., and that last year China graduated 17 PhDs in the field of underground coal gasification, while only two others graduated in the rest of the world.

Please comment on China's green technology developments and the impact these will have on green technology and jobs in the United States. Please also share your thoughts on the U.S.'s opportunity to engage in similar technology development and job creation, such as through incentives like the new advanced energy manufacturing credit Congress passed in February.

China's developments in green technology are nothing short of staggering. China is using its vast market, low-wage labor, and capital to lower prices and speed development of clean energy technology. Recent reports indicate the Chinese plan to announce new, low-carbon technology manufacturing zones that would be designed to promote and expand "green" manufacturing and exports. Similar policies in past decades helped turn many Chinese cities into manufacturing and export giants. Right now, the United States continues to lead the world in technology breakthroughs. However, we cannot count on those trends to continue without appropriate policies to encourage innovation and growth. One of our nation's biggest concerns should be that we are quickly falling behind in the race to develop, commercialize, and expand clean energy industries.

Of course, it has been a long standing concern of the U.S. labor movement that our nation lacks a comprehensive industrial policy that would promote the revitalization of our nation's manufacturing and industrial sectors. The Advanced Energy Manufacturing tax credit authorized under the American Recovery and Reinvestment Act was an important step in creating the appropriate environment for investment in clean technology. Of course, the most important step our nation can take in ensuring that firms take advantage of the tax credit is passing comprehensive legislation to place a declining cap on carbon that would ensure a domestic market for clean energy technology and provide investors and entrepreneurs the certainty they need to move forward with investments to transform and revitalize our manufacturing base.

4. Through the right clean energy policies, there is a potential to create thousands of new jobs in the U.S. We know there are various sectors that could experience job growth, but we need to have a skilled workforce in place to meet the demand. How do we ensure our workforce is trained and ready to seize these new opportunities? And as new technology is developed, how do we ensure our training programs equip Americans with durable, in-demand skills? How would you suggest we address the need to keep newly acquired skills fresh?

The sector projected to experience the greatest opportunities and growth in a clean energy technology is the building and construction sector. From energy efficiency building retrofits, to clean energy base-load power generation, to the deployment of renewable energy such as solar thermal, there are widespread and diverse opportunities. Returning to your previous question, many of the skills required to advance these climate solutions are the same skills members of America's building and construction trades unions use everyday. We are simply looking for new applications of many existing skills.

Fortunately, the joint labor-management apprenticeship and training programs sponsored by our unions and participating employers are preparing for the clean energy revolution through new curriculum development and skills training for both incoming apprentices and existing workers. Federal assistance that would enable unions to expand access to our sponsored apprenticeship programs, and ensure that workers have the skills expected to be in demand as we build a clean energy economy would help ensure our nation maintains the workforce and skill base necessary to make this important transition.

Questions from Senator Cantwell

1. In addition to thinking about the costs of policy action on climate change, we need to be just as aware of the potential costs of inaction. There is going to be tremendous energy growth, particularly in the developing world, over the next century. Energy is already a $6 trillion market, and it is growing fast. I want to be sure that the United States is the world's leading supplier of clean energy technologies to meet the exploding world demand.

How should policymakers create and structure incentives that enable US leadership in clean energy technologies? Is a consistent, stable price on fossil carbon an effective or necessary component?

We believe that programs that provide direct federal investment through grants and creative financing mechanisms are vital to ensuring U.S. leadership in clean energy technology development and deployment. The clean energy investments made through the American Recovery and Reinvestment Act were an important "down payment" on those investments. However, nothing would be a stronger incentive than a federal policy that puts a price on carbon emissions. Such a policy would send appropriate market signals through the economy that will provide certainty, spur innovation, and lead to the kinds of investments that can both reduce emissions and create jobs. A stable price on carbon is absolutely an essential component of U.S. leadership on clean energy.

How do you think we should balance the protection of existing industries with the promotion of future industries? Isn't there a real risk that if we fail to create the right investment incentives at home, we may miss out on the lucrative opportunities that will accompany global leadership in clean energy?

There is no doubt that the longer we wait to act the further our nation will lag behind in the race to develop the clean energy solutions every nation will need to make the kind of emissions reductions science tells us is necessary to prevent dangerous climate impacts. The structure and framework of a future carbon emissions trading system will determine the extent to which new policies prevent job losses and encourage job growth. First we believe any emissions targets in the early years of a cap and trade program should be consistent with the availability of commercial technology to reduce emissions, and provide enough time for the efficiency investments many believe represent our best opportunity for low-cost emissions reductions. We strongly support adequate allocations of allowance value to consumers through local power distribution companies that will help moderate sudden increases in electricity prices that could result in job losses, as well as a larger burden on rate payers. We also believe an allocation of allowances to an output based rebate system for energy-intensive, trade exposed industries, in addition to an appropriate WTO consistent border adjustment mechanism are vital to protecting existing workers in those industries. There is an achievable balance between what must be done to protect our environment and what must be done to encourage renewed economic growth.

2. One of the most important ways we can stimulate economic growth and job creation through climate policy is by creating consistent price signals and long-term incentives for investment in innovation and new energy technologies.

In any policy involving the auctioning of emissions allowances, do you think that price controls—both price floors and ceilings—are necessary to manage volatility and uncertainty?

Our union absolutely believes that an upper and lower limit on emissions allowance prices is necessary in an emissions trading system. Such a mechanism can not only prevent unanticipated or unbearable economic costs for workers, but will help prevent market manipulation. Ensuring both a floor and ceiling on allowance prices is among our union's highest priorities.

Would a well-designed, price collar (i.e. explicit upper and lower bounds for the price of allowances) provide sufficient assurances for substantial investment in capital-intensive, low-carbon energy systems such as CCS and nuclear, as well as other, more conventional renewable energy technologies?

A well-designed price collar in our view would provide sufficient assurances for such investments. The capital-intensive investments you mention require long-term planning and assurances that they will be supported by the market. Many of them will take many years -- even decades -- to reach full commercial deployment. Others will require additional incentives, such as CCS "bonus allowances", to spur deployment prior to the point at which they would be deployed based on a carbon price signal alone. In our experience in the utility sector, regulatory and cost-certainty are two key factors energy producers consider when making decisions regarding capital investments. A price collar would ensure a stable economic basis on which to plan those long term investments.

Questions from Senator Carper

1. In 2005, we had several hearings in the Environmental and Public Works (EPW) Committee regarding a three pollutant bill called Clear Skies which was sponsored by Senator Voinovich. Clear Skies attempted to reduce emissions of sulfur dioxide, nitrogen oxide, and mercury from our nation's fossil-fuel power plants. During one of our EPW Clear Skies hearings, Jim Connaughton, the Chairman of the Council on Environmental Quality at the time, was asked if we would have mercury reduction technology available to meet a 90 percent reduction requirement by 2010. In his answer, he stated: "mercury specific control technologies are not expected to provide 90% control on all key combinations of coal type and control technology in this timeframe."

Moving to 2009, after intensive Department of Energy research and development and aggressive mercury targets implemented in over 17 states, the mercury control technology story is a very different one. Just last month GAO reported that mercury control technology for power plants was not only commercially available, but can achieve 90 percent reductions for all coal types and costs little when compared to other pollution control devices. Do you agree we've made great strides in our mercury control technology for coal plants over the past four years?

Based on my conversation with workers in our construction division and the locals whose members install pollution technology, the answer to your question is yes. Mercury control technology has improved significantly, including both pre- and post-combustion control technology for coal-fired boilers. Performance continues to vary based on coal types and the interaction with other applied pollution control technologies. In some settings, a 90% reduction from some facilities is difficult to guarantee. However, we have no evidence to suggest that GAO's conclusion that mercury controls at coal plants are able to achieve reductions on average of between 80% and 90% is not accurate.

2. With a cap on carbon, and with the carbon capture and sequestration (CCS) deployment incentives within S.1733 reported out of the EPW Committee last week, do you believe we will see a similar advancement in the deployment of carbon capture and sequestration technology as we did with mercury control technology?

Do you believe S.1733 would likely promote the early deployment of CCS deployment as opposed to a straight carbon tax? If so, why?

Our union has been tremendously encouraged by the breakthroughs and developments we have seen related to carbon capture and storage technology. The early reports from the demonstration being conducted by American Electric Power at their Mountaineer facility in West Virginia seem to indicate that technology performance is exceeding expectation. While much of the results of technology performance evaluation have not been made public, technology providers that work with our union report that they expect continued improvements to technology performance, particularly as it relates to efficiency. We are tremendously optimistic that with the assistance of the incentives provided in S. 1733 there will be widespread adoption and deployment of CCS. One major coal fired utility recently indicated that, should the United States proceed with climate legislation similar to S. 1733, 75% of its fleet of coal plants would be retrofitted with CCS technology. Of course, issues related to licensing and liability at storage sites remain an important factor that will determine the speed and extent to which technology is deployed.

We strongly believe the cap and trade system, early deployment incentives, and advance payment "bonus allowances" for CCS included in S. 1733 are a much more effective incentive than a carbon tax. The long term certainty that emissions reductions of more than 80% by 2050 are the standard our nation must achieve will be a stronger incentive for coal-fired utilities to invest in CCS.

3. As you know, I believe policies to reduce emissions from transportation should play a major role in any climate legislation. Transportation produces 30% of U.S. emissions and transportation emissions have been growing faster than any other sector.

Working with my colleagues in EPW, we currently have $3 billion per year in the climate change legislation to build transportation projects that reduce emissions. This investment will create roughly 80,000 jobs per year. The unemployment rate in the construction industry currently stands at 18.7 percent. The transportation funding in the Kerry-Boxer bill will not only reduce emissions, but also put hundreds of thousands of Americans back to work. I call that a win-win.

Mr. Breehey, what does 18.7 percent unemployment in the construction industry mean for the members of your union? Do you believe investment in clean transportation projects is an important component of climate change legislation?

The members of the America's building and construction trades unions are struggling substantially to cope with the current rates of unemployment. It is a tremendous burden on families, communities, and local governments.

We urge the Congress to take immediate dramatic action to get some relief to America's workers through policies that create jobs. While our union has been fortunate to have suffered less than others when it comes to lack of employment opportunities, all unions right now have members that are looking for opportunities to get off the bench and go to work. Unemployment is also having a negative impact on union health and welfare and pension funds whose contributions from workers and contributing employers are based on hours worked. We must take dramatic steps to reverse these declines.

Absolutely, we strongly support aggressive affirmative investments in clean transportation that will create jobs. As you point out, these are both opportunities to reduce emissions, reduce dependence on foreign oil, and create jobs. We greatly appreciate your efforts to ensure climate legislation includes strong transportation investments and look forward to working with you to protect and grow these investments as the legislative process moves forward.

Questions from Senator Grassley

1. Mr. Breehey, you testified that a U.S. climate bill should include a border measure that would require importers of energy-intensive goods to purchase emissions allowances.

Are you suggesting that importers should be required to purchase such allowances even if the U.S. producers of the competing goods receive their allowances for free?

If so, would you please explain how that would be consistent with international trade rules?

While our union does strongly support the inclusion of border measures in climate legislation, we recognize that such a provision must be structured in a way that is consistent with our obligations under the WTO. We know that the failure to do so would undermine the effectiveness of such a measure. Any border measure must account for the allocation of free allowances to energy-intensive, trade exposed industries. A border measure might only be phased in as free allowance allocations are phased out. While I lack the legal expertise to address your question in great deal, we are working with other unions and trade advisers to ensure that any border measure not only provides protection to domestic industries and workers, but is consistent with global trade rules.

2. Mr. Breehey, you argue that if we include a border measure in a climate bill, it will provide significant leverage to U.S. climate negotiators.

But I'm not convinced that you're right.

For example, most of China's production of energy intensive goods is for its domestic needs.

According to 2005 production data, in the steel, aluminum, and cement sectors, China exported less than 2.5% of what it produced to the United States.

That's not much of a stick.

What is your reaction?

First, we believe it is wrong to assume that future trends in global shipments and trade in energy intensive goods will remain as they are today. While China continues to develop rapidly, there will eventually be excess capacity beyond what is required to meet their domestic needs. Further, we believe a border measure should apply not only to raw materials, but to manufactured products that are significantly comprised of energy intensive materials. In addition, it is important that a border measure not only target imports from China, but also from other major exporting countries. For example, Mexico and Thailand are major exporters of cement to the United States. We must ensure that the passage of comprehensive climate legislation does not reduce the competitiveness of the U.S. cement industry relative to those countries.

United States Senate
Committee on Finance

Sen. Chuck Grassley · Iowa
Ranking Member

Opening Statement of Sen. Chuck Grassley
"Climate Change Legislation: Considerations for Future Jobs"
November 10, 2009

It's the responsibility of Congress to weigh the costs and benefits of every policy decision it makes, and the bigger the issue the more important it becomes. This isn't the Environment Committee so this isn't the place for a detailed examination of the purported environmental benefits of any climate change proposal, although that is an important part of the equation. This committee's expertise is in the costs and economic impacts of new taxes. It therefore has the relevant expertise for evaluating the costs associated with climate change legislation.

Today's hearing about the impact of climate change legislation on jobs builds on lessons this committee has learned from past hearings. Last year, then-Congressional Budget Office Director Peter Orszag testified that under a cap and trade system, price increases for energy would necessarily increase; "skyrocket" is the term President Obama has used. Dr. Orszag explained, "Such price increases would stem from the restriction on emissions and would occur regardless of whether the government sold emission allowances or gave them away. Indeed, the price increases would be essential to the success of a cap-and-trade program..."

Both he and Robert Greenstein of the left-leaning Center on Budget and Policy Priorities also testified that the impact of those price increases would fall most severely on the lowest income Americans.

Some have tried to claim that a cap and trade bill would somehow make enough money through auctioning allowances to cover increased costs to American families, but this ignores the fact that this money will be taken from the American people in the first place. The current director of the CBO, Doug Elmendorf, addressed this issue when he testified before this committee in May. In response to written questions, he made clear that, "the allowances that are created under a cap and trade program do not add wealth to the economy. Rather, they are simultaneously a cost and a source of income." He also made it very clear that the value of allowances would "...inevitably fall short of the total economic effects of the policy..." In other words, there is no free lunch here.

At that same hearing, Dr. Elmendorf testified that "...by channeling productive resources toward reducing (the risk of damage from climate change) rather than toward producing goods and services that are measured in gross domestic product (GDP), such policies would be likely to reduce GDP relative to what otherwise would occur." In testimony just last month before the Energy and Natural Resources Committee, he confirmed that economic productivity and jobs would be lost as a result of the House-passed cap and trade bill. Despite this, the more stringent Senate version of this legislation is incredibly titled the "Clean Energy Jobs and American Power Act." Like any government regulation, there will inevitably be winners and losers, and we'll be hearing a little about both in today's hearing. However, an honest cost-benefit assessment requires that we first stop trying to sell this policy as if it will have no cost for Americans and accept the basic economic principle that there is no such thing as a free lunch.

TESTIMONY OF DR.KENNETH P. GREEN
BEFORE THE
SENATE COMMITTEE ON FINANCE

"CLIMATE CHANGE LEGISLATION: CONSIDERATIONS FOR FUTURE JOBS"
NOVEMBER 10, 2009

Chairman Baucus, Senator Grassley, Members of the Committee:

Thank you for inviting me to testify today on this important topic.

I have submitted to the record two AEI policy studies on the issue before us today, which are part of the research base underlying what I am about to say.

I have spent the last 15 years analyzing public policy at think tanks in both the U.S. and Canada, with an emphasis on air pollution, climate change, and energy policy. Specifically, I have studied market-based mechanisms for dealing with pollution problems of all sorts, and have studied cap-and-trade as it has made its appearance in conventional air pollution control, and now in greenhouse gas control.

What I can tell you, based on my research is this: cap-and-trade, the core of greenhouse gas control legislation today, is an inappropriate policy tool for the control of greenhouse gases that will cause significant economic harm, and will kill and export jobs, for little or no environmental benefit.

Current legislation applies an emission-trading model to an unsuitable pollutant. For emission trading to work, you need readily available technology to capture emissions, or alternative sources of energy that lets some people generate surplus emission reductions so they can sell them to others. We had that with SO_2: we don't have that with CO_2. With CO_2, as EPA acknowledges, we're dependent on offsets to control costs, and offsets are notoriously slippery. Even the economists who first developed the theory and practice of cap-and-trade have said that it is not a suitable mechanism for greenhouse gas control. It hasn't worked in Europe, and it won't work here.

By design, and despite provisions that try to hide this from the public the carbon-control bills now circulating will increase energy prices, slowing economic growth, killing jobs, and reducing competitiveness.

And this is a one-way street, since cap-and-trade doesn't only cap emissions, it caps economic growth. When GDP goes up, energy consumption does also, and so does carbon permit price, choking off continued growth; The tighter the emission cap, the tighter the economic straight-jacket.

As energy prices rise, and American companies find themselves less competitive, businesses and jobs will flow to countries without greenhouse gas controls, and without stringent environmental controls of any kind, potentially allowing emissions to increase. The remedy to this, border tax adjustment, is only likely to cause a trade war that will further damage the U.S. economy.

As increased energy costs raise the cost of all U.S. goods and services, consumption will decline, causing still more job losses.

Legislation now before Congress will cause regional and sectoral winners and losers, and will unjustly redistribute and export wealth from industrial, coal-powered state industries to industries in states with greater hydro, nuclear, or natural gas resources. It will send U.S. taxpayer dollars abroad to countries that are our economic competitors, and sometimes geo-political adversaries.

Cap-and-trade creates a new, poorly understood financial instrument that can be used to leverage debt, potentially creating a massive carbon bubble that bursts once it becomes clear we can't afford to maintain the scheme.

Finally, cap-and-trade, and all carbon control, for that matter, puts a bounty on eco-system: As carbon control favors biofuels, more eco-system will be planted over, and farmland used to grow fuel instead of food. A recent article in *Science* observes that attempting to limit CO_2 concentrations to 450 ppm (the currently stated goal of carbon controls) would cause bioenergy crops to expand to displace virtually **all** of the world's natural forests and savannahs by 2065 and actually **increase** global greenhouse gas emissions.

As for the claim that the green-energy provisions of current climate legislation will create "green" jobs that can't be exported, this is simply nonsense. As I testified before another Senate committee, governments do not create jobs they just move them around, inevitably resulting in less jobs on net. Economists have known this for over 150 years. Europe has seen much of its green industry exported, and the U.S. is already seeing solar cell and windmill production moving to China.

The only thing worse than no energy policy, is bad energy policy, and that is what S. 1733, and approaches like it represent: bad energy policy, wrapped up in deceptive terminology that tried to hide the true nature of the legislation.

Thank you for allowing me to speak to you today on this timely and important issue. I look forward to your questions.

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Climate Change: Caps vs. Taxes

By Kenneth P. Green, Steven F. Hayward, and Kevin A. Hassett

As the Kyoto Protocol's 2012 expiration date draws near, a general theme dominates the global conversation: leadership and participation by the United States are critical to the success of whatever climate policy regime succeeds the Kyoto Protocol. Two general policy approaches stand out in the current discussion. The first is national and international greenhouse gas (GHG) emissions trading, often referred to as "cap-and-trade." Cap-and-trade is the most popular idea at present, with several bills circulating in Congress to begin a cap-and-trade program of some kind. The second idea is a program of carbon-centered tax reform—for example, the imposition of an excise tax based on the carbon emissions of energy sources (such as coal, oil, and gasoline), offset by reductions in other taxes. In this paper we will address the strengths and weaknesses of both ideas and the framework by which legislators should evaluate them.

The framing of a global climate regime presents a classic chicken-and-egg problem: the United States does not wish to enter into a regime of economically costly emission caps or taxes that would have the effect of driving industry and jobs to nations such as China and India that do not participate in such caps. China and India, however, are unlikely to enter into a restrictive regime unless the United States goes first, and even then, only so long as the policy regime does not threaten serious constriction of their economies. It is often assumed that if the United States goes first, developing nations will eventually follow, but this is by no means assured. Both China and India have repeatedly declared that they are not prepared to make even a delayed commitment at this time.

Given these policy uncertainties—and other uncertainties about the eventual impacts of climate change in terms of severity, distribution, and timing—there are two guideposts policymakers should keep in mind. The first is that the United States can only effectively impose a national regulatory regime (though such a regime could eventually be harmonized with international efforts). The second is that, given the current uncertainty, policy should conform as much as possible to a "no regrets" principle by which actions undertaken can be justified separately from their GHG emissions effects in the fullness of time, such that nonparticipation by developing nations will disadvantage the United States in the global marketplace as little as possible.

While the United States may wish to join with other nations in setting a post-Kyoto emissions goal, it should be wary of joining an international emissions-trading or other regulatory regime. One of the less-remarked-upon aspects of the Kyoto Protocol, and any prospective successor treaty on that same model, is that it represents an unprecedented kind of treaty obligation for the United States. Most treaties involve direct actions and policies of governments themselves, such as trade treaties that bind nations' tariff levels and affect the private sector of the economy only indirectly. Kyoto and its kin go beyond government policy to affect the private sector directly or require the

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Kenneth P. Green is a resident scholar, Steven F. Hayward is the F. K. Weyerhaeuser Fellow, and Kevin A. Hassett is a senior fellow and director of economic policy studies at AEI. This *Environmental Policy Outlook* is available online at www.aei.org/publication26286/.

1150 Seventeenth Street, N.W., Washington, D.C. 20036 202.862.5800 www.aei.org

government to control the private sector and the investment decisions of the private sector to an unprecedented degree. It is not governments that emit GHGs, after all. Between the asymmetries of legal and regulatory regimes across nations, the United States should think hard about the dilution of sovereignty that a binding GHG treaty represents, even if the United States agrees with the basic objective of reducing carbon emissions.

Problems with Emissions Trading for GHG

Some economists favor the idea of emissions trading for its elegance in achieving least-cost emissions reductions while avoiding the manifold difficulties of prescriptive "command-and-control" regulation from a centralized bureaucracy. But this is something of a false choice, as such regulation is a deeply troubled policy option. While trading may be superior to command-and-control, it is not necessarily superior to other alternatives, such as carbon-centered tax reform.

While trading may be superior to command-and-control, it is not necessarily superior to other alternatives, such as carbon-centered tax reform.

There are a number of emissions-trading success stories that, upon inspection, suggest significant limitations to the applicability of emissions trading for GHG emissions. Enthusiasts for cap-and-trade point first to our sulfur dioxide (SO_2) trading experience under the 1990 Clean Air Act Amendments. It is claimed that the costs of SO_2 abatement through trading turned out to be dramatically lower than economists had forecast for a prescriptive regime, wherein the Environmental Protection Agency (EPA) would have mandated control technologies on individual coal-fired power plants. But a closer look shows this success to have been uneven. There has been significant volatility in emission permit prices, ranging from a low of $66 per ton in 1997 to $860 per ton in 2006, as the overall emissions cap has been tightened, with the price moving up and down as much as 43 percent in a year.[1] Over the last three years, SO_2 permit prices have risen 80 percent a year, despite the EPA's authority to auction additional permits as a "safety valve" to smooth out this severe price volatility.

Several other aspects of the SO_2-trading program are of doubtful applicability to GHGs. First, SO_2 trading was only applied to a single sector: initially, only 110 coal-fired power plants were included in the system, but it subsequently expanded to 445 plants. While coal-fired power plants account for roughly one third of U.S. carbon dioxide (CO_2) emissions and will therefore be central to a GHG cap-and-trade program, a comprehensive GHG emissions-trading program will have to apply across many sectors beyond electric utilities, vastly complicating a trading system.

Second, SO_2 and CO_2 are not comparable targets for emissions reduction. Reducing SO_2 emissions did not require any constraint on end-use energy production or consumption. Coal-fired power plants had many low-cost options to reduce SO_2 emissions without reducing electricity production. Some switched to low-sulfur coal (abetted in large part by railroad deregulation in the 1980s, which made transport of Western low-sulfur coal more economical than previously). The cost of "scrubbers"—industrial devices which capture SO_2 and sequester it—turned out to be lower than predicted. Other utilities emphasized more use of natural gas. The impact on ratepayers and consumers was modest.

CO_2 is different: it is the product of complete fuel combustion. There is no "low-CO_2 coal," and the equivalent of SO_2 scrubbers does not yet exist in economical form.[2] At the margin there is some opportunity for GHG emissions reductions through substitution—increased use of natural gas (which emits less CO_2 per unit of energy than coal) and possibly nuclear power—but the inescapable fact is that any serious reduction in CO_2 emissions will require a suppression of fuel combustion. This is going to mean lower energy consumption and higher prices, at least in the intermediate term.

Even though confined to a segment of a single sector of energy use, the SO_2 emissions-trading regime was far from simple. There were complicated allocation formulas to distribute the initial emissions permits. Despite the best efforts to create objective criteria, at the end of the day, the allocation of emission permits involves some arbitrary discretion. For political reasons there were special subsidies and extra allowances for the benefit of high-sulfur coal interests. Most trading in the early years took place between power plants within the same company.

Establishing allowances and accounting systems for GHG emissions across industries is going to be vastly more difficult and highly politicized. The forest products industry, for example, will reasonably want credits for creating carbon sinks in the trees it plants and harvests, but the manufacturing sector that uses these wood products as a raw material will want credit for sequestering carbon. The difference will have to be split in some arbitrary manner that will surely introduce economic distortions in the marketplace. The auto industry will want credits for GHG innovations, while industries and businesses of all kinds will lobby for credits for reducing mobile source emissions from changes to their auto and truck fleets. There are going to be winners and losers in this allocation process. Multiply this problem across sectors and industries and it becomes evident that a GHG emissions-trading system is going to be highly complex and unwieldy, and too susceptible to rent-seeking influence in Washington. The problem of politically adjusting competing interests will be compounded on the international scale. The long-running diplomatic conflicts that can be observed over purported subsidies for aircraft (i.e., Boeing versus Airbus) and the European Union's agricultural subsidies and trade barriers are examples of the kinds of conflicts that will be endemic to any international emissions-trading scheme.

The favored solution to these problems is to over-allocate the number of initial permits both to ease the cost and to encourage the rapid start-up of a market for trades. This was the course the European Union took with its Emissions Trading System (ETS), and it has very nearly led to the collapse of the system. Because emissions permits were over-allocated, the price of emissions permits plummeted, and little—if any—emissions reductions have taken place because of the ETS. The over-allocation of initial permits merely postpones both emissions cuts and the economic pain involved. Economist Robert J. Shapiro notes:

> As a result of all of these factors and deficiencies, the ETS is failing to reduce European CO_2 emissions. . . . [T]he European Environmental Agency has projected that the EU is likely to achieve no more than one-quarter of its Kyoto-targeted reductions by 2012, and much of those "reductions" will simply reflect credits purchased from Russia or non-Annex-I countries [developing countries], with no net environmental benefits.[3]

As economist William Nordhaus observes:

> We have preliminary indications that European trading prices for CO_2 are highly volatile, fluctuating in a band and [changing] +/- 50 percent over the last year. More extensive evidence comes from the history of the U.S. sulfur-emissions trading program. SO_2 trading prices have varied from a low of $70 per ton in 1996 to $1500 per ton in late 2005. SO_2 allowances have a monthly volatility of 10 percent and an annual volatility of 43 percent over the last decade.[4]

Nordhaus points out the ramifications of such volatility, observing that "[s]uch rapid fluctuations would be extremely undesirable, particularly for an input (carbon) whose aggregate costs might be as great as petroleum in the coming decades," and that "experience suggests that a regime of strict quantity limits might become extremely unpopular with market participants and economic policymakers if carbon price variability caused significant changes in inflation rates, energy prices, and import and export values."[5]

Nordhaus is not alone in this concern about price volatility. Shapiro similarly observes:

> Under a cap-and-trade program strict enough to affect climate change, this increased volatility in all energy prices will affect business investment and consumption, especially in major CO_2 producing economies such as the United States, Germany, Britain, China and other major developing countries.[6]

Additional pitfalls and dilemmas of emissions trading can be seen through a review of the spectacular trading failure of the RECLAIM (Regional Clean Air Incentives Market) emissions-trading program in Southern California. Launched in 1994 after three years of development, RECLAIM set in motion an emissions-trading program targeting SO_2 and nitrogen oxides (NO_x) emissions, and eventually hoped to expand to include volatile organic compound (VOC) emissions. All three types of emissions are important precursors to ozone formation in the greater Los Angeles air basin. RECLAIM, for the first time, offered swaps between stationary and mobile sources: stationary sources such as oil refineries could help reach their emissions reduction targets by purchasing old, high-polluting automobiles and trucks and taking them off the road—a cost-effective measure in a voluntary demonstration program. The South Coast Air Quality Management District (SCAQMD) estimated that SO_2 and NO_x would be reduced by fourteen and eighty tons per day, respectively, by the year 2003, at half the cost of the usual prescriptive method of regulation.[7] There was great public support and enthusiasm for the program at the outset.

RECLAIM never came close to operating as predicted, and was substantially abandoned in 2001. Between 1994 and 1999, NO_x levels fell only 3 percent, compared to a 13 percent reduction in the five-year period before RECLAIM. There was extreme price volatility aggravated by California's electricity crisis of 2000. NO_x permit prices ranged from $1,000 to $4,000 per ton between 1994 and 1999, but soared to an average price of $45,000 per ton in 2000, with some individual trades over $100,000 per ton. Such high prices were not sustainable, and SCAQMD removed electric utilities from RECLAIM in 2001. SCAQMD also dropped its plan to expand RECLAIM to VOCs. Despite the hope that RECLAIM would be simple and transparent, there were serious allegations of fraud and market manipulation, followed by the inevitable lawsuits and criminal investigations.

One particular problem with RECLAIM that is likely to plague any international GHG emissions-trading regime is the lack of definite property rights to the emissions allowances the program creates. A cliché of the moment is that industry would like some clarity and certainty about any prospective GHG regulatory regime. A cap-and-trade program, however, cannot provide certainty precisely because emissions allowances are not accorded real property rights by law.[8] The government can change the rules at any time, making emissions allowances worthless. This is exactly what happened to electric utilities in Los Angeles: their allowances were terminated, and the utilities were subsequently required to install specified emissions-control technologies and to pay fines for excess emissions. In effect, some Los Angeles firms had to pay three times over for emissions reductions.

A GHG emissions-trading scheme on an international level will be even more vulnerable to these kinds of unpredictable outcomes. To the extent that a GHG emissions-trading program results in international cross-subsidization of the economies of trading partners, it is going to be politically unsustainable in the long run. An international emissions-trading program is also unlikely to survive noncompliance by some of its members.

> If warming is either less pronounced than some current forecasts predict or if emissions reductions have limited effect in moderating future temperature rise . . . a severe global emissions-reduction policy through emissions trading could turn out to be the costliest public policy mistake in human history, with the costs vastly exceeding the benefits.

There are two final, overriding reasons to be doubtful about global emissions trading. It is possible that the defects of previous emissions-trading programs could be overcome with more careful design and extended to an international level, though this would require an extraordinary feat of diplomacy and substantial refinements of international law. Even if such improvement could be accomplished, it would not provide assurance against the prospect that the cost of such a system might erode the competitiveness of the U.S. economy against developing nations that do not join the system.

The second reason for skepticism about global emissions trading is that it fails the "no regrets" test. It is considered bad form nowadays to express doubt or skepticism about the scientific case for rapid and dangerous global warming in the twenty-first century. If warming is either less pronounced than some current forecasts predict or if emissions reductions have limited effect in moderating future temperature rise, however, a severe global emissions-reduction policy through emissions trading (on the order of a minimum 50 percent cut by 2050) could turn out to be the costliest public policy mistake in human history, with the costs vastly exceeding the benefits.

Could instituting a tax on the carbon emissions released by fuel use, as part of a revenue-neutral tax reform package, pass these two tests? We believe it could.

Advantages of a Revenue-Neutral, Carbon-Centered Tax Reform

Most economists believe a carbon tax (a tax on the quantity of CO_2 emitted when using energy) would be a superior policy alternative to an emissions-trading regime. In fact, the irony is that there is a broad consensus in favor of a carbon tax everywhere except on Capitol Hill, where the "T word" is anathema. Former vice president Al Gore supports the concept, as does James Connaughton, head of the White House Council on

Environmental Quality during the George W. Bush administration. Lester Brown of the Earth Policy Institute supports such an initiative, but so does Paul Anderson, the CEO of Duke Energy. Crossing the two disciplines most relevant to the discussion of climate policy—science and economics—both NASA scientist James Hansen and Harvard University economist N. Gregory Mankiw give the thumbs up to a carbon tax swap.[9]

There are many reasons for preferring a revenue-neutral carbon tax regime (in which taxes are placed on the carbon emissions of fuel use, with revenues used to reduce other taxes) to emissions trading. Among them are:

- **Effectiveness and Efficiency.** A revenue-neutral carbon tax shift is almost certain to reduce GHG emissions efficiently. As economist William Pizer observes, "Specifically, a carbon tax equal to the damage per ton of CO_2 will lead to exactly the right balance between the cost of reducing emissions and the resulting benefits of less global warming."[10] Despite the popular assumption that a cap-and-trade regime is more certain because it is a quantity control rather than a price control, such a scheme only works in very limited circumstances that do not apply to GHG control. The great potential for fraud attendant on such a system creates significant doubt about its effectiveness, as experience has shown in both theory and practice in the gyrations of the European ETS.

  The likelihood of effectiveness also cannot be said for regulations such as increased vehicle fuel economy standards. In fact, such regulations can have perverse effects that actually lead to increased emissions. By making vehicles more efficient, one reduces the cost of a unit of fuel, which would actually stimulate more driving, and, combined with increasing traffic congestion, could lead to an increase in GHG emissions rather than a decrease.

  As Harvard researchers Louis Kaplow and Steven Shavell point out, "The traditional view of economists has been that corrective taxes are superior to direct regulation of harmful externalities when the state's information about control costs is incomplete," which, in the case of carbon emissions reductions, it most definitely is.[11] And when it comes to quantity controls (as a cap-and-trade system would impose), Pizer found that

  > My own analysis of the two approaches [carbon taxes vs. emission trading] indicates that price-based greenhouse gas (GHG) controls are much more desirable than quantity targets, taking into account both the potential long-term damages of climate change, and the costs of GHG control. This can be argued on the basis of both theory and numerical simulations.

  Pizer found, in fact, that a carbon-pricing mechanism would produce expected net gains five times higher than even the best-designed quantity control (i.e., cap-and-trade) regime.[12]

- **Incentive Creation.** Putting a price on the carbon emissions attendant on fuel use would create numerous incentives to reduce the use of carbon-intensive energy. The increased costs of energy would flow through the economy, ultimately giving consumers incentives to reduce their use of electricity, transportation fuels, home heating oil, and so forth. Consumers, motivated by the tax, would have incentives to buy more efficient appliances, to buy and drive more efficient cars, and to better insulate their homes or construct them with more attention to energy conservation. A carbon tax would also create incentives for consumers to demand lower-carbon power sources from their local utilities. A carbon tax, as its cost flowed down the chains of production into consumer products, would lead manufacturers to become more efficient and consumers to economize in consumption. At all levels in the economy, a carbon tax would create a profit niche for environmental entrepreneurs to find ways to deliver lower-carbon energy at competitive prices. Finally, a carbon tax would also serve to level (somewhat) the playing field among solar power, wind power, nuclear power, and carbon-based fuels by internalizing the cost of carbon emission into the price of the various forms of energy.

- **Less Corruption.** Unlike carbon cap-and-trade initiatives, a carbon tax would create little incentive or opportunity for rent-seeking or cheating. As William Nordhaus explains:

  > A price approach gives less room for corruption because it does not create artificial scarcities, monopolies, or rents. There are no permits transferred to countries or leaders of countries, so they cannot be sold abroad for

> wine or guns. . . . In fact, a carbon tax would add absolutely nothing to the instruments that countries have today.[13]

Without the profit potential of amassing tradable carbon permits, industry groups would have less incentive to try to get credits for their favored but noncompetitive energy sources. That is not to say that tax-based approaches are immune from corruption, for they certainly are not. If set too far down the chain of production or set unevenly among energy sources, carbon taxes could well lead to rent-seeking, political favoritism, economic distortions, and so on. Foreign governments might have an incentive to undermine a trading scheme by offering incentives to allow their manufacturers to avoid the cost of carbon trading. A tax on fuels proportionate to their carbon content, levied at the point of first sale, should be less susceptible to corruption, and by delivering revenue to the government rather than to private entities, should create incentives more aligned with the government's objective.

A carbon tax, as its cost flowed down the chains of production into consumer products, would lead manufacturers to become more efficient and consumers to economize in consumption.

- **Elimination of Superfluous Regulations.** Because a carbon tax would cause carbon emissions to be reduced efficiently across the entire market, other measures that are less efficient—and sometimes even perverse in their impacts—could be eliminated. With the proper federal carbon tax in place, there would be no need for corporate average fuel economy standards, for example. California's emissions-trading scheme, likewise, would be superfluous, and its retention only harmful to the Golden State. As regulations impose significant costs and distort markets, the potential to displace a fairly broad swath of environmental regulations with a carbon tax offers benefits beyond GHG reductions.

- **Price-Stabilization.** As the experiences of the European ETS and California's RECLAIM show us, pollution-trading schemes can be easily gamed, resulting in significant price volatility for permits. Imagine one's energy bill jumping around as permits become more or less available due to small changes in economic conditions. A carbon tax would be predictable, and by raising the overall price of energy to include the tax, the portion of energy cost per unit that stems from fluctuation in market rates for fossil fuels shrinks as a percentage of the whole. That shrinkage makes the price of a given form of energy less susceptible to volatility every time there is a movement in the underlying production costs.

- **Adjustability and Certainty.** A carbon tax, if found to be too stringent, could be relaxed relatively easily over a timeframe, allowing for markets to react with certainty. If found too low to produce results, a carbon tax could easily be increased. In either event, such changes could be phased in over time, creating predictability and allowing an ongoing reassessment of effectiveness via observations about changes in the consumption of various forms of energy. A cap-and-trade system, by contrast, is more difficult to adjust because permits, whether one is the seller or the buyer, reflect significant monetary value. Permit traders would demand—and rightly so—compensation if what they purchased in good faith has been devalued by a governmental deflation of the new "carbon currency." In addition, sudden changes in economic conditions could lead to significant price volatility in a cap-and-trade program that would be less likely under a carbon-tax regime.

- **Preexisting Collection Mechanisms.** Whether at local, state, or federal levels, carbon taxes could be levied and collected through existing institutions with extensive experience in enforcing compliance, and through ready-made statutes to back up their actions. The same cannot be said for emissions-trading schemes that require the creation of new trading markets, complete with new regulations and institutions to define and enforce the value of credits.

- **Keeping Revenue In-Country.** Unlike an international cap-and-trade regime, carbon taxes—whether done domestically or as an internationally agreed-upon value—have the advantage of keeping tax payments within individual countries. This could strongly reduce the opposition to international action that has, until this point, had a strong implication of wealth redistribution overlaid on the policy discussion.

This dynamic leads to a second reason why a carbon tax is a better fit for U.S. climate policy: it offers an international analogue to our federalist approach to public policy innovation within the United States. As we have seen, there is reason to doubt the long-run effectiveness and sustainability of the EU's emissions-trading program. If the United States adopts a carbon tax approach, we will be able to compare the effectiveness of tax versus emissions trading in short order.

- **Mitigation of General Economic Damages.** As energy is one of the three most important variable inputs to economic production (along with labor and capital), raising the cost of energy would undoubtedly result in significant economic harm. Using the revenues generated from a carbon tax to reduce other taxes on productivity (taxes on labor or capital) could mitigate the economic damage that would be produced by raising energy prices. The most likely candidates for a carbon tax tradeoff would be the corporate income tax (the U.S. rate is currently among the highest in the industrialized world) and payroll taxes, the latter of which would lower the cost of employment and help offset the possibly regressive effects of higher energy prices on lower-income households. But across-the-board income tax rate cuts and further cuts in the capital gains tax could also be considered.

  Few other approaches offer this potential. Regulatory approaches such as increasing vehicle efficiency standards do not because they mandate more expensive technologies and allow the costs to be passed on to consumers without offsets (unless they are subsidized), in which case it is the general taxpayer whose wallet shrinks. Emissions-trading would allow for this if one auctioned all initial permits and used the revenue to offset other taxes. The vast majority of trading systems, however, begin with the governing entity distributing free emission credits to companies based on historical emission patterns rather than having an open auction for permits that would produce such revenue streams. Without an auction, the revenues in a trading scheme accrue only to private companies that trade in carbon permits, while the companies buying permits would pass the cost on to consumers. International emissions-trading approaches such as Kyoto's clean development mechanism are worse still: the beneficiaries of the scheme are likely to be foreign governments or private entities that can reduce (or pretend to reduce) carbon emissions more efficiently, leaving Americans with higher energy prices and no revenue stream to offset the negative impacts on productivity.

Exploring the Parameters of Carbon-Centered Tax Reform

Published estimates of an initial optimal carbon tax on fuels are in the range of $10 to $20 per ton of CO_2 emitted (in 2005 dollars). Nordhaus, for example, estimates the optimal rate for a tax implemented in 2010 to be $16 per ton of carbon and rapidly rising over time.[14] We will focus primarily on a tax rate of $15 per ton of CO_2, while also providing enough information to allow a reader to consider the likely impact of a range of possible taxes.

- **Background on Emissions.** According to the U.S. Energy Information Administration, emissions of CO_2 in the United States in 2005 equaled 6,009 million metric tons (MMT) of CO_2, an increase of twenty MMT over 2004.[15] Emissions have grown at an annual rate of 1.2 percent between 1990 and 2005. Recently, the rate has slowed, with the average annual rate between 2000 and 2005 equaling 0.5 percent.

- **Price Impacts.** Table 1, on the following page, shows the price impacts of a $15 per ton CO_2 tax under the assumption that the tax is fully passed forward. The price shown for gasoline is not in addition to that on crude oil (i.e., it is not a double-tax). It is included to show how the price levied on crude oil would change the price of the refined product.[16] This provides a rough guide to the excise tax equivalent price impacts of a tax on CO_2. We can scale the tax rates to evaluate different carbon taxes. For example, a $10 per ton tax on CO_2 would raise the price of coal by $28.55 x 0.66 = $18.84.

  A $15 CO_2 tax would raise the price of gasoline by 14¢ per gallon. A similar calculation can be made for coal-fired electricity. Using the most recent data from EPA's Emissions & Generation Resource Integrated Database (eGRID), we calculate that the average emission rate for coal-fired power plants is 2,395 pounds of CO_2 per megawatt-hour (MWh) of electricity. A $15 per ton CO_2 tax would raise the price of coal-fired electricity by 1.63¢ per kilowatt-hour (kWh), or 20 percent at an average electricity price of 8.3¢ per kWh.

Table 2 shows the impact of a \$15 per ton carbon tax on the price of major fuels used in electricity generation. Fuel prices are prices at which the carbon tax would likely be applied.[17] Not surprisingly, coal is most heavily impacted by a carbon tax, with coal's price rising by more than three-quarters with a tax of this magnitude.

- **Behavioral Responses and Revenue.** The higher energy prices in table 2 should bring about a reduction in the demand for carbon-intensive fuels. A full analysis of equilibrium changes in carbon emissions requires a Computational General Equilibrium (CGE) model, an exercise that is beyond the scope of this paper. We can, however, make a rough calculation using previously published results from CGE models. Here, we extrapolate results from the analysis of Bovenberg and Goulder of a \$25 per ton tax on carbon.[18] Table 3 presents the price and output changes for fossil fuels following the imposition of the carbon tax in Bovenberg and Goulder's study. We compute the arc elasticity as the ratio of the percentage output change to price change.

These response elasticities are not price elasticities in the usual sense, since they are the outcome of the entire general equilibrium response to the tax. These responses, for example, include a shift in electricity production away from coal toward natural gas and oil.[19] They are also relatively short-run responses, on the order of three to five years following the phased-in introduction (over three years) of the carbon tax.

The elasticities from table 3 combined with the price increases in table 2 imply the reductions in fuel use and carbon emissions seen in table 4.

TABLE 1

PRICE IMPACTS OF A \$15 CO_2 TAX

	Coal	Crude Oil	Natural Gas	Gasoline
Energy Unit	**Short Ton**	**Barrel**	**mcf**	**Gallon**
MT C/Quad Btu	25,980,000	20,300,000	14,470,000	19,340,000
Mt CO_2/Quad Btu	95,260,000	74,433,333	53,056,667	70,913,333
Btu/Energy Unit	19,980,000	5,800,000	1,027,000	124,167
Mt CO_2/Energy Unit	1.903	0.432	0.054	0.009
Tax/Energy Unit	\$28.55	\$6.48	\$0.81	\$0.14

SOURCES: Carbon content of fuels from www.eia.doe.gov/environment.html; energy content of fuels from U.S. Department of Energy (DOE), Energy Information Administration (EIA), *Annual Energy Review 2005*, DOE/EIA-0384(2005), Washington, DC: EIA, 2006.

TABLE 2

SHORT-RUN PRICE EFFECTS OF A \$15 CO_2 TAX

Energy Source	Unit	Price Per Unit (\$)	Tax Per unit of Energy	Price Change (%)
Coal	short ton	\$34.29	28.55	83.3
Crude Oil	barrel	\$60.23	6.48	10.8
Natural Gas	thousand cubic feet	\$8.53	0.82	9.6

SOURCE: Prices are 2006 averages as reported by Energy Information Administration (EIA). Coal statistics from EIA, "Receipts, Average Cost and Quality of Fossil Fuels," available at www.eia.doe.gov/cneaf/electricity/epm/table4_2.html; crude oil statistics from EIA, "Refiner Acquisition Cost of Crude Oil," available at http://tonto.eia.doe.gov/dnav/pet/pet_pri_rac2_dcu_nus_a.htm; and natural gas statistics from EIA, "Natural Gas Prices," available at http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm. Unit taxes computed from table 1.

NOTE: Tax is assumed to be fully passed forward.

TABLE 3

IMPLIED OUTPUT ELASTICITIES

	Price Change (%)	Output Change (%)	Output Elasticity
Coal Mining	54.50	-19.10	-0.350
Oil	13.20	-2.10	-0.159
Natural Gas	13.20	-2.10	-0.159

SOURCE: A. Lans Bovenberg and Lawrence Goulder, "Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?" in *Distributional and Behavioral Effects of Environmental Policy*, eds. Carlo Carraro and Gilbert E. Metcalf (Chicago: University of Chicago Press, 2000), table 2.2.

NOTE: Output elasticity is the ratio of the percent change in quantity demanded divided by the percent change in price, multiplied by negative one.

As table 4 shows, CO_2 emissions are reduced by 663 million metric tons, a decline of 11 percent. Most of the reduction in emissions comes from reduced coal use. A static estimate of CO_2 tax revenue (ignoring the behavioral response) suggests that a $15 tax would raise $90.1 billion per year in the near term.[20] Allowing for the emissions reductions calculated in table 4, the tax would raise $80.2 billion per year. Clearly, the tax would raise less money in future years as greater reductions in carbon emissions occurred through improvements in efficiency, fuel switching, or new technologies like carbon capture and sequestration.[21] The revenue estimate, however, does not factor in growth in demand for electricity nor the baseline growth in carbon emissions that would result in the absence of any carbon policy.

Applying this approach to different carbon tax rates gives the results for emissions reductions and tax revenues seen in table 5.

While these results are useful for providing a ballpark estimate of the impact of a carbon tax, more detailed modeling will be required to refine them further. Our estimates are broadly consistent with results from more detailed CGE modeling of U.S. carbon policies.[22]

TABLE 4
EMISSIONS REDUCTIONS FOR A $15 TAX

Energy Source	**Output Change (%)**	**CO_2 Emissions (MMT)**	**Reduction in CO_2 Emissions (MMT)**
Coal	–29.2	2,046	597.1
Crude Oil	–1.7	2,832	48.4
Natural Gas	–1.5	1,130	17.2
Total	N/A	6,009	662.8

SOURCE: Authors' calculations.

TABLE 5
VARYING THE TAX RATE

Tax Rate Per Ton ($)	**Emissions Reductions (%)**	**Tax Revenue ($ billions, annual rate)**
10	7.40	55.7
15	11.0	80.2
20	14.7	102.5
25	18.4	122.6

SOURCE: Authors' calculations.

TABLE 6
CARBON TAXES AS A SHARE OF OTHER TAXES

Tax Rate Per Ton ($)	**Tax Revenue ($ billions)**	**Personal Income Tax (%)**	**Corporate IncomeTax (%)**	**Payroll Taxes (%)**
10	55.7	6.0	20.0	7.0
15	80.2	8.6	28.8	10.1
20	102.5	11.1	36.8	12.9
25	122.6	13.2	44.1	15.4

SOURCE: Authors' calculations.

- **Potential Uses of Revenue.** Carbon tax revenues could be used for a number of purposes, such as lowering payroll and corporate income taxes, funding tax relief to low-income earners most affected by increased energy prices, or a combination of these. Table 6 reports the carbon tax revenue from table 5 as a percentage of various tax collections in 2005, as reported in the most recent administration budget submission.

A $15 per ton CO_2 tax raises enough revenue to reduce the corporate income tax by over one-quarter and income or payroll taxes by roughly 10 percent. In a policy brief for the Brookings Institution and the World Resources Institute, economist Gilbert Metcalf estimated that a rebate of the employer and employee payroll tax contribution on the first $3,660 of earnings per worker in 2003 would be sufficient to make the carbon tax both revenue- and distributionally neutral.[23]

Distributional neutrality may well impact the desirability and political feasibility of a carbon tax, but there are efficiency considerations as well. There is substantial literature on the "double dividend" that examines the economic conditions under which a carbon tax can be paired with a reduction in other taxes in a manner that improves the overall efficiency of the economy. Where such a double dividend is available, a carbon tax swap would be desirable, even if the environmental benefit of reduced carbon emissions failed to be realized.

The concept of the double dividend stems from the observation that a tax on an environmental externality not only helps curb the externality (dividend 1), but also provides revenue with which other distorting taxes can be reduced, thereby providing efficiency gains (dividend 2).[24]

The double dividend comes in different levels.[25] The "weak" double dividend states that if one has an economically distorting tax, using environmental tax proceeds to lower it provides *greater efficiency gains* than returning the proceeds lump sum to those who pay the environmental tax. An intermediate form of the double dividend hypothesis is that there exists a distortionary tax, such that using environmental tax proceeds to lower this tax will *improve welfare*, setting aside environmental benefits.[26] A strong form claims that a welfare gain will occur when environmental proceeds replace those of the typical distorting tax.

A tax swap would create economy-wide incentives for energy efficiency and lower-carbon energy, and by raising the price of energy, would also reduce energy use.

The weak double dividend is uncontroversial,[27] while the strong double dividend is somewhat more controversial.[28] Criticisms notwithstanding, logic suggests that the pursuit of a strong double dividend is desirable as a matter of public policy. To that end, it would seem much more desirable in terms of efficiency to pursue capital tax reduction as a revenue feedback than other choices, as the current treatment of capital in the tax code is quite far from the optimal tax of zero, and the efficiency gains from a reduction in a payroll tax would likely be minimal if labor is, as is generally accepted, supplied relatively inelastically.

It should be noted that cap-and-trade systems and carbon-tax systems can be designed so they are quite similar. If, for example, emissions are capped and permits are auctioned off, then one could, after observing the auction price, set a carbon tax that leads to a similar emissions and revenue outcome. Cap-and-trade systems, however, generally have been pursued as an alternative to revenue-raising taxes, and often allocate the permits according to some formula rather than through an auction. For the purposes of exposition, we compared a carbon tax to this latter form of the cap-and-trade system. One should remember that cap-and-trade proposals can be adjusted to raise revenues, and the revenues could then be used to pursue the double dividend. In that case, the relative merits of a carbon tax would be diminished.

Achieving a More Efficient System

A cap-and-trade approach to controlling GHG emissions would be highly problematic. A lack of international binding authority would render enforcement nearly impossible, while the incentives for cheating would be extremely high. The upfront costs of creating institutions to administer trading are significant and likely to produce entrenched bureaucracies that clamor for ever-tighter controls on carbon emissions. Permit holders will see value in further tightening of caps, but will resist efforts outside the cap-and-trade system that might devalue their new carbon currency. Higher energy costs resulting from trading would lead to economic slowdown, but as revenues would flow into for-profit coffers (domestically or internationally), revenues would be unavailable for offsetting either the economic slowdown or the impacts of higher energy prices on low-income earners.

A program of carbon-centered tax reform, by contrast, lacks most of the negative attributes of cap-and-trade, and could convey significant benefits unrelated to GHG reductions or avoidance of potential climate harms, making this a no-regrets policy. A tax swap would create economy-wide incentives for energy efficiency and lower-carbon energy, and by raising the price of energy would also reduce energy use. At the same time, revenues generated would allow the mitigation of the economic impact of higher energy prices, both on the general economy and on the lower-income earners who might be disproportionately affected by such a change. Carbon taxes would be more difficult to avoid, and existing institutions quite adept at tax collection could step up immediately. Revenues would remain in-country, removing international incentives for cheating or insincere participation in carbon-reduction programs. Most of these effects would remain beneficial even if science should determine that reducing GHG emissions has only a negligible effect on mitigating global warming.

A modest carbon tax of $15 per ton of CO_2 emitted would result in an 11 percent decline in CO_2 emissions, while raising non–coal-based energy forms modestly. Coal-based energy prices would be affected more strongly, which is to be expected in any plan genuinely intended to reduce GHG emissions. A number of possible mechanisms are available to refund the revenues raised by this tax. On net, these tools could significantly reduce the economic costs of the tax and quite possibly provide economic benefits.

For these reasons, we conclude that if aggressive actions are to be taken to control GHG emissions, carbon-centered tax reform—not GHG emission trading—is the superior policy option.

AEI editorial associate Nicole Passan worked with Messrs. Green, Hayward, and Hassett to edit and produce this Environmental Policy Outlook.

Notes

1. United States Environmental Protection Agency (EPA), "Progress Reports," available at www.epa.gov/airmarkets/progress/progress-reports.html.

2. Sequestration projects currently appear to be not only very expensive, but they also reduce net power generation by as much as 20 percent, further aggravating the cost that will be passed along to consumers and rate payers.

3. Robert J. Shapiro, "Addressing the Risks of Climate Change: The Environmental Effectiveness and Economic Efficiency of Emissions Caps and Tradable Permits, Compared to Carbon Taxes," February 2007, 22, available at www.theamericanconsumer.org/Shapiro.pdf.

4. William Nordhaus, "Life after Kyoto: Alternative Approaches to Global Warming Policies" (NBER working paper no. W11889, December 2005), 15.

5. Ibid., 22.

6. Robert J. Shapiro, "Addressing the Risks of Climate Change: The Environmental Effectiveness and Economic Efficiency of Emissions Caps and Tradable Permits, Compared to Carbon Taxes."

7. RECLAIM covered 390 stationary sources of NOx and fourteen stationary sources of SO_2, which represented only 17 percent of total basin-wide NO_x emissions and 31 percent of basin-side SO_2 emissions.

8. The Clean Air Act forbids it, in fact. SCAQMD's RECLAIM regulations read: "An RTC [RECLAIM Trading Credit] shall not constitute a security or other form of property." Section 4 of the RECLAIM regulations reiterated this point: "Nothing in District rules shall be construed to limit the District's authority to condition, limit, suspend, or terminate any RTCs or the authorization to emit which is represented by a Facility Permit." (Cited in James L. Johnston, "Pollution Trading in La-La Land," *Regulation* [Fall 1991], available at www.cato.org/pubs/regulation/reg17n3-johnston.html.)

9. Carbon Tax Center, "Who Supports," available at http://carbontax.wrkng.net/who-supports/.

10. William Pizer, "Choosing Price or Quantity Controls for Greenhouse Gases," *Resources for the Future Climate Issues Brief* 17 (July 1999).

11. Louis Kaplow and Steven Shavell, "On the Superiority of Corrective Taxes to Quantity Regulation," *American Law and Economics Review* 4, no. 1 (2002).

12. William Pizer, "Choosing Price or Quantity Controls for Greenhouse Gases."

13. William Nordhaus, "Life after Kyoto: Alternative Approaches to Global Warming Policies," 15.

14. Ibid.

15. U.S. Department of Energy (DOE), Energy Information Administration (EIA), *Emissions of Greenhouse Gases in the United States 2005*, DOE/EIA-0573(2005), Washington, DC: DOE, 2006. Total GHG emissions equaled 7,147 million metric tons CO_2 equivalent using hundred-year global warming potentials. Note that a simple conversion of other GHGs (i.e., methane, nitrous oxides, HFCs, and PFCs) does not exist. The global warming potential depends on the time horizon. We focus on CO_2 only in this study, though, ideally, a carbon tax would also tax these non-CO_2 emissions.

16. This is a standard assumption borne out by CGE modeling. See, for example, A. Lans Bovenberg and Lawrence Goulder, "Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?" in *Distributional and Behavioral Effects of Environmental Policy*, eds. Carlo Carraro and Gilbert. E. Metcalf (Chicago: University of Chicago Press, 2000), 45–85.

17. We assume the tax on coal would be applied for electric utilities and major industrial coal users. Note that 91 percent of domestic and imported coal is consumed by electric utilities. (DOE, EIA, *Emissions of Greenhouse Gases in the United States 2005*.) The tax on crude oil is levied at refineries, and the tax on natural gas at the city gate.

18. A. Lans Bovenberg and Lawrence Goulder, "Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?"

19. Increased coal prices could also lead to increased demand for imported oil, an important policy consideration outside the scope of this paper.

20. Carbon taxes can be reported in either units of carbon or CO_2. To convert a tax rate per unit of carbon dioxide to a rate per unit of carbon, multiply the CO_2 rate by 44/12 (the mass difference between carbon and CO_2). Thus, a tax of $10 per ton of CO_2 is equivalent to a tax of $36.67 per ton of carbon.

21. The recent coal study by researchers at the Massachusetts Institute of Technology suggests that carbon capture and sequestration is cost competitive at a carbon price of $30 per ton of CO_2. See John Deutch and Ernest Moniz, *The Future of Coal* (Massachusetts Institute of Technology, 2007), available at http://web.mit.edu/coal/.

22. Sergey Paltsev et al., *Assessment of U.S. Cap-and-Trade Proposals*, report 146 (Cambridge, MA: MIT Joint Program on the Science and Policy of Global Change, 2007), available through http://mit.edu/globalchange/www/abstracts.html#top.

23. Gilbert Metcalf, *A Green Employment Tax Swap: Using a Carbon Tax to Finance Payroll Tax Relief* (Washington, DC: Brookings Institution–World Resources Institution, 2007).

24. Don Fullerton and Gilbert E. Metcalf, "Environmental Taxes and the Double Dividend Hypothesis: Did You Really Expect Something for Nothing?" *Chicago-Kent Law Review* 73, no. 1 (1998): 221–56.

25. See Lawrence H. Goulder, "Environmental Taxation and the 'Double Dividend': A Reader's Guide," *International Tax and Public Finance* 2 (1995): 157–83, for a thorough taxonomy of the various double dividends. Also see A. Lans Bovenberg and Lawrence Goulder, "Neutralizing the Adverse Industry Impacts of CO_2 Abatement Policies: What Does It Cost?"

26. The terminology of intermediate and strong double dividends is due to Goulder, "Environmental Taxation and the 'Double Dividend': A Reader's Guide."

27. Mustafa Babiker, Gilbert E. Metcalf, and John Reilly, "Tax Distortions and Global Climate Policy," *Journal of Environmental Economics and Management* 46 (2003): 269–87. Babiker et al. show that it is possible, however, to find taxes such that lump-sum replacement dominates, lowering a distortionary tax.

28. A. Lans Bovenberg and Ruud de Mooij, "Environmental Levies and Distortionary Taxation," *American Economic Review* 84, no. 4 (1994): 1085–89. See also Lawrence H. Goulder, "Environmental Taxation and the 'Double Dividend': A Reader's Guide."

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Waxman-Markey: An Exercise in Unreality

By Steven F. Hayward and Kenneth P. Green

After months of hearings and backroom give-and-take, the House of Representatives on June 26 passed HR 2998, the American Clean Energy and Security Act of 2009, known as Waxman-Markey. The final draft of the bill was over 1,200 pages, and the House vote was extremely narrow: 219–212. Senate passage is uncertain. What is needed now as the Senate begins its deliberations is a clear idea of exactly what Waxman-Markey contains, how it is likely to affect the economy, and whether it will address the problem of global warming in a serious way. Our view is that the legislation is an exercise in unreality.

Waxman-Markey is a bundle of contradictions. It seeks to make carbon energy more expensive but does not ask consumers to pay higher energy prices—at least for the first decade of its operation. Hence, Waxman-Markey allocates 85 percent of the emission rights it creates to existing emitters (coal-fired power plants, electric utilities, and manufacturers) *for free*, rather than auctioning the emissions permits, as President Obama and environmentalists have long advocated. It seeks a first in economic history: rationing without scarcity or price inflation. Thus, Waxman-Markey allows generous "offsets" so that carbon-based energy does not, in fact, become scarce. The bill does, however, contain a multitude of new regulations; product-efficiency mandates; and spending programs that will require extensive managerial attention from both the public and private sectors, though to much less effect than promised.

In addition to having many other pernicious effects, the Waxman-Markey bill will establish a new commodity—carbon credits—that will almost certainly spawn new Wall Street derivatives and, hence, make necessary another large area of financial transactions for the federal government

Key points in this *Outlook*:

- The Waxman-Markey legislation will do for climate change what Sarbanes-Oxley did for financial regulation: establish a big new bureaucracy that imposes substantial costs on the economy.
- The legislation enumerates six hundred tasks the EPA must perform and gives other agencies significant administrative roles.
- The last time GHG emissions were at the Waxman-Markey target for 2050 was 1910. However, the liberal use of "offsets" suggests that even if Waxman-Markey works perfectly, fossil fuel emissions will be reduced by no more than 50 percent.
- Countries such as Grenada and Belize have per-capita emissions close to the Waxman-Markey 2050 levels.
- The legislation is a giveaway to people the environmentalists claim are destroying the planet.
- Waxman-Markey is unrealistic and will not fix the problem.

Steven F. Hayward (shayward@aei.org) is the F. K. Weyerhaeuser Fellow at AEI. Kenneth P. Green (kgreen@aei.org) is a resident scholar at AEI.

to oversee, at a time when the federal government is struggling to manage regulation of the banking sector. Indeed, a careful review of this copious legislation reveals it to be the energy and climate policy equivalent of Sarbanes-Oxley financial regulation, creating an extensive new bureaucracy and imposing substantial economic costs on the productive economy while achieving few of its stated objectives. Just as Sarbanes-Oxley did little or nothing to expose and prevent the excessive risk and inflated asset values of the housing and financial sector, Waxman-Markey will do little to achieve genuine greenhouse gas (GHG) emission reductions or curb the risks of global warming. The "cap" on emissions is so porous that it may be more accurately thought of as a hairnet, with many ways for GHG emissions to escape the cap.

The idea of cap-and-trade involves setting a total cap on national GHG emissions—chiefly carbon dioxide (CO_2), but also a number of other gases[1]—and establishing a market for a finite number of allowances to emit GHGs up to the total amount of the cap, which would be lowered gradually over time. Economists and policy analysts have long favored emissions trading of this kind as a more efficient and less bureaucratic means of reducing pollution than the traditional "command-and-control" regulation of the Clean Air and Clean Water Acts (though in the case of CO_2, most economists and many policy analysts believe a carbon tax would be a better instrument). These acts involve detailed prescriptive regulation that is often costly and litigious. The 1990 Clean Air Act treatment of sulfur dioxide is an example of a successful emissions trading program. But this comparatively small program is not necessarily applicable to GHGs.[2] In any event, the presumed economic efficiencies of emissions trading contemplated in Waxman-Markey will not make up for the fact that the bill essentially requires the wholesale remaking of the entire energy sector over the course of the next four decades—a feature conspicuously different from previous emissions trading programs, which imposed minimal constraints on fossil fuel use.

Expansion of Governmental Roles

Much of the discussion thus far has been concerned with the typical disputes over estimates of the cost of such a program, but there has been little notice of how an approach that is supposed to be an alternative to command-and-control regulation will involve a massive interagency bureaucracy to execute it, with undoubtedly substantial compliance costs for the private sector. Waxman-Markey contemplates a primary administrative role for the Environmental Protection Agency (EPA); the bill requires the EPA's administrator to perform over six hundred tasks in connection with the operation of the law. One wonders whether the EPA administrator will have time for any other environmental issues.

The bill also creates primary administrative roles for the Department of Energy (DOE), the Department of Transportation, the Department of Agriculture, the State Department, the U.S. Agency for International Development (USAID), and the Federal Energy Regulatory Commission, along with substantial involvement of the Commodity Futures Trading Commission, the Federal Reserve, the Securities and Exchange Commission, the Federal Aviation Administration, and the Department of Housing and Urban Development. There are also multiple planning and reporting mandates for state governments. It is impossible to tally up the total number of new tasks Waxman-Markey is asking the government to perform (several general clauses will no doubt generate additional functions beyond those specifically enumerated), but the coordination and consultation requirements for the responsibilities of all these agencies promise a bonanza for lawyers and consultants and endless interagency meetings that will keep the chairs warm in countless conference rooms.

Unrealistic Emissions Reduction Targets

No amount of nimble administration can make up for the sheer unreality of the Waxman-Markey GHG emissions reduction targets. The text of Waxman-Markey endorses the target of holding global CO_2 levels to no more than 450 parts per million (ppm)—up from about 385 ppm today and rising at present trends to more than 700 ppm by 2100 if nothing is done. To grasp how extraordinary this target is, consider this analysis the International Energy Agency offered in its *World Energy Outlook Summary* for 2008, released last fall in Paris:

> The scale of the challenge in the 450 Policy Scenario is immense: the 2030 emissions level for the world as a whole in this scenario is less than the level of projected emissions for non-OECD countries alone in the Reference Scenario. *In other words, the OECD countries alone cannot put the world onto the path to 450-ppm trajectory, even if they were to*

> *reduce their emissions to zero*. Even leaving aside any debate about the political feasibility of the 450 Policy Scenario, it is uncertain whether the scale of the transformation envisaged is even technically achievable, as the scenario assumes broad deployment of technologies that have not yet been proven. The technology shift, if achievable, would certainly be unprecedented in scale and speed of deployment.[3]

It is worth pondering the italicized sentence. It means that even if the United States and its fellow industrialized nations ceased to exist, emissions from developing nations, not included in the Kyoto Protocol and unlikely to be included in the successor treaty, would carry the CO_2 level well beyond 450 ppm by midcentury. According to an EPA estimate made last year, the Waxman-Markey emissions target, even if fully achieved, would lower global CO_2 levels in the year 2095 by 25 ppm at most and would, therefore, have a negligible effect on holding back global warming.

Two Questions about the Target

Waxman-Markey sets the ambitious target of reducing total U.S. GHG emissions by 83 percent below 2005 levels by the year 2050 (with intermediate benchmarks at 2020 and 2030). Thus, the cap and the allowances sold pursuant to it will be lowered from a peak of 5.4 billion tons in 2016 to just a little over 1 billion tons in 2050. Before considering how the allowances are being allocated, it is worth concentrating for a moment on the overall emissions target for 2050. In 2005, the baseline year, the United States emitted a little more that 6 billion tons of CO_2 and another billion tons of other GHGs such as methane and nitrous oxide. But CO2, as the byproduct of fossil fuel consumption and the most abundant GHG, is the principal focus of policy. An 83 percent reduction in CO_2 emissions in 2050 would be slightly over 1 billion tons.

The first threshold question is: when were U.S. CO_2 emissions from fossil fuel use last at 1 billion tons, the year 2050 target? From DOE historical statistics on energy consumption, it is possible to estimate that the United States last emitted 1 billions tons in the year 1910, when the nation's population was only 92 million people, per-capita income (in 2007 dollars) was only $5,964, and total GDP (also in 2007 dollars) was about $551 billion—about one-twentieth the size of the U.S. economy today (see table 1).

Table 1

U.S. CO_2 Emissions: 1910 and 2005 Levels

	1910	2005
U.S. CO_2 emissions from fossil fuels (million metric tons)	1,002.3	6,032.3
U.S. GDP (billion 2008 $)	$572	$14,264
Per-capita income (2008 $)	$6,196	$46,913
Population	92,228,000	303,000,000
Fossil fuel energy (quadrillion British thermal units)	14.261	87.760
Per-capita CO_2 emissions (tons)	10.9	20.3

Source: Energy Information Administration and authors' calculations.

By the year 2050, however, the United States is expected to have a population of 420 million, according to Census Bureau projections—more than four times the population of 1910. In order to reach the 83 percent reduction target, per-capita CO_2 emissions will have to be no more than 2.4 tons per person—only one-quarter the level of per-capita emissions in 1910.

This suggests a second threshold question: when did the United States last experience per-capita CO_2 emissions of only 2.4 tons? From the limited historical data available, it appears that this was about 1875. In 1875, the nation's GDP (in 2008 dollars) was $147 billion, per-capita income (in 2008 dollars) was $3,300, and the population was only 45 million. (It is possible that per-capita CO_2 emissions were never this low even before the advent of widespread fossil fuel use, as wood burning by Americans in the nineteenth century may have produced more than 2.4 tons of CO_2 per capita. Much depends on the emissions coefficient for wood burning and how, since wood is biomass rather than a fossil fuel, regrowth of forestland is credited in carbon accounting. In 1875, twice as much energy was generated from burning wood than fossil fuels.)

To understand how extreme an 83 percent reduction in CO_2 emissions for the United States in the year 2050 is, consider the following: Are there any modern industrialized nations whose CO_2 emissions come close to the putative target for 2050? The advanced industrialized nations with the lowest current per-capita CO_2 emissions are France and Switzerland. France famously generates about 80 percent of its electricity with nuclear power, which is carbon-free, while Switzerland generates most of its electricity with nuclear and hydropower, which is also carbon-free. Both nations are also compact compared to the United States, with low energy needs for transportation. Yet France's per-capita CO_2 emissions are 6.59 tons, and Switzerland's are 6.13 tons—both more than twice the per-capita level the United States must achieve to reach the 80 percent reduction target. Table 2 shows nations that currently have per-capita emissions close to the 2050 target level (again, the U.S. level in 1875).

TABLE 2
2005 PER-CAPITA EMISSIONS

	Per-capita CO_2 emissions	Per-capita income (2006 $)	CO_2 emissions intensity
Argentina	3.4	4,470	0.47
Belize	2.9	3,570	0.87
Brazil	1.6	3,550	0.54
Botswana	2.3	5,590	0.60
France	6.6	34,600	0.29
Grenada	2.1	3,860	0.56
Jordan	3.3	2,460	1.65
Mauritius	2.6	5,250	0.75
Syria	2.7	1,380	1.99
United States, 1875	2.4	3,178	n/a
United States, 2005	19.4	43,560	0.54

SOURCE: Energy Information Administration.

This is not the profile of a "carbon-constrained" world, as a popular euphemism has it; this is the profile of a *carbon-starved* world. This kind of reduction is not going to be achieved, and it is not going to be seriously attempted. Waxman-Markey tacitly admits this through its inclusion of "offsets"—that is, reductions in GHG emissions through means *other* than reduction in fossil fuel energy use—along with the hope that carbon sequestration can be implemented cost-effectively on a large scale, thus allowing coal-fired electricity to be *expanded* in the coming decades.

Loopholes

"Offsets" refer principally to increased carbon storage in biomass—essentially, this means planting more trees—both here in the United States and in developing nations. International offsets will involve U.S. companies paying developing nations to reduce deforestation or to increase reforestation efforts. Waxman-Markey will allow up to 2 billion tons a year of such offsets. Despite the bill's attempts to ensure that overseas offset projects will be authentic (the State Department and USAID will monitor and certify overseas offset projects, and the EPA will establish an Offsets Integrity Advisory Board to avoid the kind of fraud and manipulation that was the undoing of a similar United Nations program under the Kyoto Protocol), it is likely that American consumers will end up paying for efforts developing nations are going to undertake anyway. China, for example, has an extensive reforestation program underway that it may well choose to "sell" to the United States for offset credits. This would follow China's previous gaming of Europe's cap-and-trade program, when China bilked the European Union of billions of dollars by building two chemical plants that would produce a highly powerful GHG and then building two cleanup plants to "offset" emissions.

Waxman-Markey's mandate for a renewable energy standard (RES) for electric utilities has similar loopholes. The original draft of Waxman-Markey included an RES mandate that electric utilities generate 20 percent of their power from renewable sources (tightly defined to exclude hydropower and nuclear power) by the year 2020, up from about 4 percent today. But as the allowable renewable technologies (chiefly solar, wind, and biomass) are much more expensive than conventional fossil fuel sources, the revised Waxman-Markey bill allows the 20 percent standard to be achieved through "conservation and efficiency" measures rather than noncarbon energy. The National Renewable Energy Laboratory and several environmental groups, including the Union of Concerned Scientists and the Breakthrough Institute, have produced analyses of the RES that conclude the standard will generate very little new renewable power than will otherwise occur under the DOE's current "business-as-usual" forecast. The EPA's latest analysis of the revised bill, released on June 23, found that Waxman-Markey would result in less new renewable power than under a business-as-usual scenario.iv (The EPA analysis has to be read carefully to recognize this finding; on the surface, it appears that the amount of renewables will go up sharply under Waxman-Markey, but it reaches this conclusion by assuming significantly lower electricity demand over the coming decades, such that the present modest growth rate of renewables will account for a larger share of a smaller pie.) All in all, it appears that the actual GHG reductions would be very modest—less than 5 percent of the total reduction sought under Waxman-Markey.[5]

Even if Waxman-Markey works according to design, it appears the net reduction in GHG emissions by 2050 would only be about 50 percent—still an ambitious target, but considerably less than the 83 percent reduction advertised in the bill's summary. In other words, instead of reducing fossil fuel CO_2 emissions from 6 billion tons to 1 billion tons—the stated target—the use of offsets and other gimmicks means that CO_2 emissions will only be reduced to about 3 billion tons. The "83 percent reduction by 2050" represents false advertising.

Between the offsets, allowance giveaways, generous assumptions about the cost and development of carbon sequestration for coal-fired electricity, and optimistic hopes for falling costs for other prospective energy sources, estimates of the cost of Waxman-Markey over the long run differ by more than an order of magnitude. Advocates of Waxman-Markey point to estimates from the EPA and the Congressional Budget Office (CBO) showing average cost to households of less than $100 per year (in 2008 dollars) by 2020, down from a previous estimate of about $175 a year—roughly equal to buying one extra postage stamp a day. On the other end of the scale, the Heritage Foundation estimates the cost will be more than $1,800 per household (again in constant 2008 dollars) by 2020 and will rise sharply in the years after 2020 when the cap begins to be lowered and the allowances begin to be auctioned rather than given away.

Taxpayer Burden of Reduction

It is not necessary to enter into intense and technical debate over economic methodology to get to the heart of what is problematic about Waxman-Markey. The EPA's latest analysis of the bill offers a range of estimates similar to the CBO's. The EPA offers multiple scenarios of how Waxman-Markey might play out because the agency acknowledges that "uncertainties could significantly affect results"; depending on which scenario one selects, the cost in 2020 will be between $84 and $105 per household per year, but rising to as much as $1,000 a household by 2050. Here is a puzzle: when the EPA scored the Lieberman-Warner cap-and-trade bill—which also sought an 80 percent reduction in GHG emissions by 2050—last year, the agency reported much higher estimates for what on the surface looks identical to Waxman-Markey.[6]

For Lieberman-Warner, the estimated household cost in 2020 was as much as $386 per household per year, rising to as much as $2,268 in 2050 (again in constant 2008 dollars). The difference is simple: in the analysis of Lieberman-Warner, the EPA "assumed the full cost of allowances are passed on to consumers," while its analysis of Waxman-Markey concludes that the cap-and-trade "policy has a relatively modest impact on U.S. consumers *assuming the bulk of revenues from the program are returned to households*. . . . A policy that failed to return revenues from the program to consumers would lead to substantially larger losses in consumption."[7]

It makes a large difference if you ask Americans to pay for a policy. Instead, Waxman-Markey will set up a marketplace for trading a new commodity—carbon credits—on Wall Street while attempting to ensure that the proceeds and profits are fully redistributed, like an income tax with a 100 percent refund. The EPA's newest analysis also omits the impacts that higher energy rates engendered by Waxman-Markey will have on the economy in terms of reduced economic growth and likely job losses. Of course, the proceeds of freely allocated allowances will not be redistributed evenly, and many will not even flow to consumers, as the EPA analysis makes clear in findings that the advocates of Waxman-Markey have chosen not to advertise:

- A cap-and-trade policy increases the price of energy-intensive goods and services, such as transportation, food, and medical care. The majority of this price increase is ultimately passed on to consumers.

- Before accounting for the way in which allowances are allocated or revenues are redistributed, lower-income households are disproportionally affected by a GHG cap-and-trade policy because they spend a higher fraction of their incomes on energy-intensive goods.

- Freely distributed allowances to firms tend to be very regressive. Higher-income households may actually gain at the expense of lower-income households under this policy. This is because the asset value of the allowances flows to households in the form of increased stock values or capital gains, which are concentrated in higher-income households.[8]

Conclusion

Perhaps the most astonishing aspect of the Waxman-Markey bill is that so many environmentalists support it. Had President George W. Bush and the GOP Congress proposed four or five years ago the free allocation of emission permits in the same fashion as Waxman-Markey, environmentalists would have lined up to denounce and oppose the bill. Not only is Waxman-Markey a titanic giveaway to the very people that environmentalists have blamed for destroying the planet, it will prevent the EPA from regulating GHGs under the Clean Air Act and from undoing the environmental nightmare of corn ethanol. To their credit, a few environmental organizations, as well as people such as NASA's James Hansen, have denounced Waxman-Markey,[9] but the major environmental groups seem willing to go along with the bill no matter how absurd and ineffective it becomes. Some believe that the Senate will "fix it," though it is more likely that if the bill gets through the Senate, it will end up allocating perhaps 150 percent of the emission permits instead of the 85 percent, as it stands now.[10]

In their determination to reduce GHG emissions in the near term rather than the long term, climate campaigners could have achieved a vastly better result with less cost and little bureaucracy through a simple, revenue-neutral $15-per-ton carbon tax. But perhaps the creation of a vast energy bureaucracy is really the main point of the exercise. After all, a $15 carbon tax will only generate, according to several models, about a 10 percent decrease in CO_2 emissions by 2020, which is more than Waxman-Markey will deliver. But it will still be far short of the goal the climate campaigners seek of an 83 percent reduction by 2050, implying that future carbon taxes would have to be much higher. But this also points to the inevitability of turning our policy attention to measures other than carbon suppression, such as geoengineering or "air capture"—that is, technical methods of removing carbon content from the air.[11]

Abigail Haddad contributed research for this Outlook.

Notes

1. Other GHGs include methane, nitrous oxide, sulfur hexafluoride, hydroflourocarbons, nitrogen triflouride, and perflourocarbons, as well as any other anthropogenic gas designated as a greenhouse gas by the Environmental Protection Agency (EPA) administrator. See *American Clean Energy and Security Act of 2009*, HR 2998, 11th Congress, 1st sess., 543.

2. See the detailed discussion of this point in Kenneth P. Green, Steven F. Hayward, and Kevin A. Hassett, "Climate Change: Caps vs. Taxes," *Energy and Environment Outlook* no. 2 (June 2007), available at www.aei.org/outlook/26286.

3. *World Energy Outlook Summary* 2008 (Paris: International Energy Agency, 2008), 48. Emphasis added.

4. EPA, "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress," June 23, 2009, available at www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis.pdf (accessed July 2, 2009).

5. See ibid.; Patrick Sullivan, Jeffrey Logan, Lori Bird, and Walter Short, "Comparative Analysis of Three Proposed Federal Renewable Electricity Standards" (National Renewable Energy Laboratory Technical Report NREL/TP-6A2-45877, Golden, CO, May 2009), available at www.nrel.gov/docs/fy09osti/45877.pdf (accessed July 2, 2009); and Jessie Jenkins, "Climate Bill Analysis Part 16: EPA Projects Fewer Renewables under Waxman Markey Than Business as Usual," Breakthrough Blog, June 25, 2009, available at http://thebreakthrough.org/blog/2009/06/climate_bill_analysis_part_16.shtml#more (accessed July 2, 2009).

6. EPA, "EPA Analysis of the Lieberman-Warner Climate Security Act of 2008 S. 2191 in 110th Congress," March 14, 2008, available at www.epa.gov/climatechange/downloads/s2191_EPA_Analysis.pdf (accessed July 7, 2009).

7. EPA, "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress," 4. Emphasis added.

8. Ibid., 49.

9. Friends of the Earth, "House Green Economy Bill Falls Short: Polluting Special Interests Have Weakened Bill; It Now Falls Far Short of Vision for Clean Energy Future Obama Articulated during Campaign," June 8, 2009, available at www.foe.org/sites/default/files/Waxman-MarkeyBillFallsShort.pdf (accessed July 2, 2009).

10. This could be the outcome, for example, if the Senate embraces any variation of Senator Jeff Bingaman's (D-N.M.) proposal for a price collar on carbon emissions and a "safety valve," under which additional emission permits would be automatically created and allocated if the price of permits exceeds a fixed upper bound price.

11. See Nicola Jones, "Climate Crunch: Sucking It Up," *Nature* 458, no. 1094–1097 (2009), available at www.nature.com/news/2009/090429/full/4581094a.html (accessed July 2, 2009).

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Climate Change: The Resilience Option

By Kenneth P. Green

> "The willow which bends to the tempest, often escapes better than the oak which resists it; and so in great calamities, it sometimes happens that light and frivolous spirits recover their elasticity and presence of mind sooner than those of a loftier character."
>
> —Albert Schweitzer

The Earth's climate is prone to sharp changes over fairly short periods of time. Plans that focus simply on stopping climate change are unlikely to succeed; fluctuations in the Earth's climate predate humanity. Rather than try to make the climate static, policymakers should focus on implementing resilience strategies to enable adaptation to a dynamic, changing climate. Resilience strategies can be successful if we eliminate current risk subsidies and privatize infrastructure.

Recent climate research tells us that our climate is not the placid, slow-changing system people assume it to be. Instead, it is prone to sharp changes over fairly short periods of time. Whether those changes are natural or caused by human actions, we now know that we live in a world of greater climatic risks. Previous generations did not think about, plan for, or factor in these risks when they sited their cities and decided how to build and manage them. While planning was done for weather in what was considered a largely predictable system, little thought was given to making cities resilient to climate variability. As efforts to reduce greenhouse gas (GHG) emissions fail, we need to consider alternative plans and actions to reduce the risks we face.

The United Nations Intergovernmental Panel on Climate Change (IPCC) has always discussed the idea of adaptation to climate change as a second- or third-best response—something to be done only after every possible effort has been made to reduce GHG emissions. Both governmental and environmental groups have generally been hostile to adaptation-based responses to climate change, as they view such approaches as surrender—an acceptance of the idea that GHG emissions will continue, that the climate will change, and that people will come to believe they can adapt. They fear that a focus on adapting to climate change would detract from a focus on mitigating emissions.

There will be arguments about mitigating GHG emissions for many years (and perhaps decades) to come, but our new understanding of how variable our climate can be suggests we should broaden our climate policy focus by

Key points in this *Outlook*:

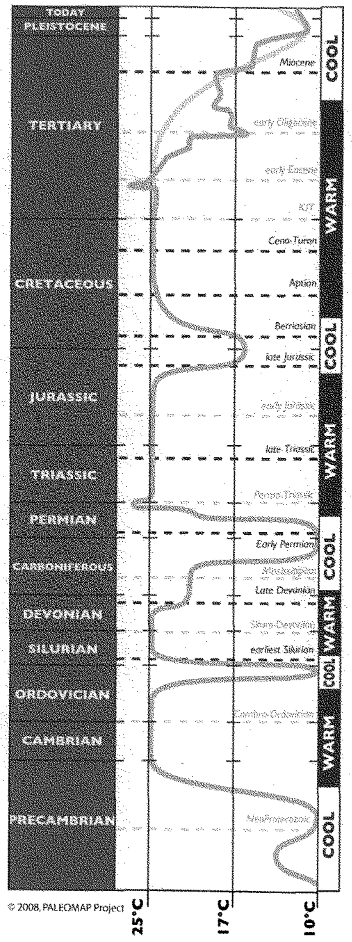
- Climate change is almost impossible to stop.
- While working on that problem, we need to shift policymaking to resilience building and adaptation.
- This can be successful if we eliminate current risk subsidies and privatize infrastructure.

Kenneth P. Green (kgreen@aei.org) is a resident scholar at AEI.

1150 Seventeenth Street, N.W., Washington, D.C. 20036 202.862.5800 www.aei.org

strengthening our efforts to facilitate adaptation. We should focus on building resilience as an approach to protecting ourselves from the risks of climate change as superior to a static approach that singles out only one possible climate influencer (the GHGs) and largely ignores natural climate variability.

FIGURE 1
EARTH'S LONG-TERM CLIMATE HISTORY



SOURCE: Christopher R. Scotese, "The Paleomap Project" (Paleomap website, 2002), available at www.scotese.com/climate.htm.

This *Outlook* discusses our variable climate and outlines an agenda for building climate resilience that can be implemented immediately and that could offer significant protection for future generations from climate variability.

Our Variable Climate

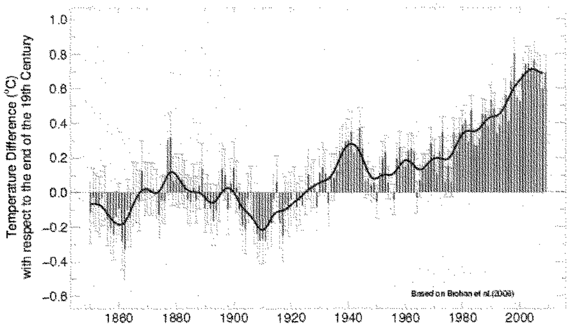
Whether viewed in long- or short-term periods, the Earth's climate history is one of variability, not stasis. Our planet has moved into and out of ice ages and warm periods for as long as we have evidence of historic climate. Figure 1 shows the longest-term picture of climate variability scientists have developed, which uses measured and proxy data. Proxy data consist of estimated temperatures (or other climate variables such as atmospheric moisture) developed by studying what are, in essence, climate fossils: tree rings, ice cores, fossil diatoms, boreholes, fossilized plant leaves, and so on. While proxy data should be considered less reliable than empirical data (meaning that the farther back we look, the more hazy the picture becomes), the scientific paleotemperature reconstructions clearly show the huge variability of the Earth's climate.[1]

The causes of global climate change are a combination of astronomical, geological, oceanographic, geographical, and biological "forcings." Forcings are things that can change the Earth's balance of incoming and outgoing radiation, making the climate warmer or cooler. On the astronomic side of the equation are changes in solar output and cosmic wind, as well as the angle and inclination of the Earth with respect to the sun. On the geological side are variations in volcanic activity or oceanic GHG flux and the response of atmospheric water vapor to climate change. On the biological side of the equation are changes in GHG emissions caused by animals (termites, ruminants, humans) and the production and sequestration of atmospheric carbon by plants and other photosynthetic organisms (such as phytoplankton). On the geographical side, changes in reflectivity of the land through changes in land use and the emission of different amounts of reflective and absorptive particulate pollution can also affect the local climate.

For more recent time periods, scientists have data of slightly better reliability (though there are still problems with data quality). The land temperature record shows that the climate has indeed been changing in the last century. As figure 2 shows, according to the surface temperature record, there have been five stages of change since 1850, when measurements began. From 1910 to 1940, the Earth experienced a period of warming; from 1940 through 1970, a pronounced cooling; from 1970 to 2000 a pronounced warming; from 2000 to the present, the rate of warming has flattened out and begun to decline.

FIGURE 2

GLOBAL AVERAGE NEAR-SURFACE TEMPERATURES, 1850–JUNE 2009



SOURCE: UK Met Office, "Annual Global and Hemispheric Surface Temperatures," HadCrut3 data set, www.metoffice.gov.uk/climatechange/science/monitoring/temperatures.html.
NOTE: The solid bars show the global annual average near-surface temperature anomalies from 1850 to June 2009. The error bars show the 95 percent uncertainty range on the annual averages. The thick line shows the annual values after smoothing with a twenty-one-point binomial filter.

The last published report of the United Nations IPCC says that "[m]ost of the observed increase in global average temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."[2] Others dispute this assertion, arguing that climate models are attributing too much influence to GHGs in the atmosphere.[3]

This *Outlook* does not focus on the question of climate change causality (there are plenty of studies that do), but it is fair to say that scientific understanding of which factors contribute to changes in the Earth's climate is still in a very early stage. Even the experts at the IPCC acknowledge this to be the case. Figure 3, from the Fourth Assessment Report of the IPCC, shows how limited scientific understanding of climate forcing really is. Scientific understanding of potential anthropogenic forcings is often medium-low to low. The same applies to scientific understanding of the nonbiological factors in climate change: articles disputing the role of solar output, cosmic ray flux, ecological GHG contributions, and responses are published on an ongoing basis.[4] From a policy perspective, the important policy question is less about the *cause* of climate variability than about the best response to climate variability, whether manmade or natural.

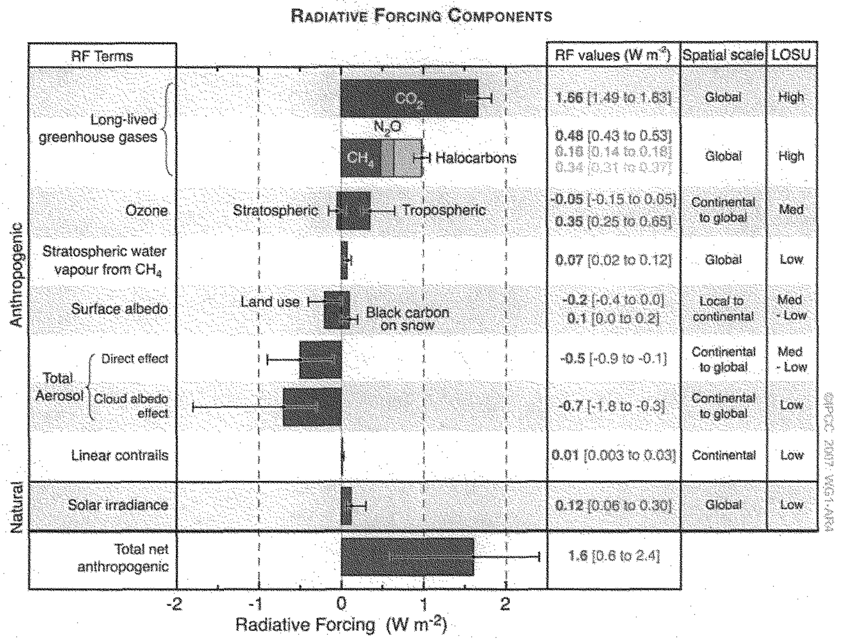
What Is Better, Climate Resilience or Climate Stasis?

In general, the mainstream response to the issue of climate change has been reactive, pessimistic, authoritarian, and resistant to change. Those alarmed about a changing climate would stand athwart the stream of climate history and cry "stop, enough!" Rather than working to cease human influence on climate, they want to find a way to make the climate stand still. This focus on creating climate stasis has led to policy proposals that would have been laughed at or dismissed as wacky conspiracy theories in the 1980s. But mainstream anti–climate change activists are proposing nothing less than the establishment of global weather control through energy rationing, regulations, and taxes, all managed by a global bureaucracy with a goal of leading humanity into a future that will become smaller, more costly, and less dynamic over time. Environmental groups, along with organizations like the United Nations IPCC, are calling for nothing less than imposing climate stasis on a chaotic system.

Consider the climate bill now before Congress: the Waxman-Markey *American Climate and Energy Security Act*. Waxman-Markey sets the ambitious target of reducing total U.S. GHG emissions by 83 percent below 2005 levels by the year 2050 (with intermediate benchmarks at 2020 and 2030). Thus, the cap and the allowances sold pursuant to it will be lowered from a peak of 5.4 billion tons in 2016 to just a little over 1 billion tons in 2050. As my colleague Steven F. Hayward and I have pointed out elsewhere, these targets are absurd.[5] From Department of Energy historical statistics

FIGURE 3

GLOBAL MEAN RADIATIVE FORCINGS, WITH LEVELS OF SCIENTIFIC UNDERSTANDING



SOURCE: IPCC, "2007: Summary for Policymakers," *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (New York and Cambridge: Cambridge University Press, 2007), 4, available at www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf (accessed September 28, 2009).

NOTE: Global average radiative forcing estimates and ranges in 2005 for anthropogenic carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). The net anthropogenic radiative forcing and its range are also shown. These require summing asymmetric uncertainty estimates from the component terms and cannot be obtained by simple addition. Additional forcing factors not included here are considered to have a very low LOSU. Volcanic aerosols contribute an additional natural forcing but are not included in this figure due to their episodic nature. The range for linear contrails does not include other possible effects of aviation on cloudiness.

on energy consumption, it is possible to estimate that the United States last emitted 1 billion tons in the year 1910, when the nation's population was only 92 million people, per-capita income (in 2008 dollars) was only $6,196, and total GDP (also in 2008 dollars) was about $572 billion—about one-twenty-fifth the size of the U.S. economy today. By the year 2050, however, the United States is expected to have a population of 420 million, according to Census Bureau projections—more than four times the population of 1910. In order to reach the 83 percent reduction target, per-capita carbon dioxide (CO_2) emissions will have to be no more than 2.4 tons per person—only one-quarter the level of per-capita emissions in 1910.

When did the United States last experience per-capita CO_2 emissions of only 2.4 tons? From the limited historical data available, it appears that this was about 1875. In 1875, the nation's GDP (in 2008 dollars) was $147 billion, per-capita income (in 2008 dollars) was $3,300, and the population was only 45 million.[6]

My colleague Kevin A. Hassett, Hayward, and I have also written elsewhere about the problems with cap-and-trade and suggested that a revenue-neutral carbon tax would be preferable,[7] but that, too, represents an effort to impose stasis on a dynamic system simply using more efficient means. A carbon tax is, to be sure, vastly superior to a cap-and-trade system, but there are doubts that it is politically possible to enact one in a way that is actually revenue-neutral and is not abused by politicians who will look to tax those they dislike and rebate the taxes to groups they favor, namely, those that are most inclined to vote for their party.

A more forward-looking, optimistic, and free-market approach to the risks of climate variability accepts that the climate has been, is, and will be variable; focuses on the risks of variability; and looks for ways to build resilience in the face of that change, regardless of cause.

FIGURE 4
APPROPRIATE STRATEGIES FOR DIFFERENT STATES OF KNOWLEDGE

		Amount of knowledge about intervention measures	
		Small	**Great**
Knowledge of the nature and scope of risks and future conditions	**High**	More resilience, less interception	Interception
	Low	Resilience	More resilience, less interception

SOURCE: Adapted from Aaron Wildavsky, *Searching for Safety* (New Brunswick, NJ: Transaction Publishers, 1988), 122.

Aaron Wildavsky's Resilience Paradigm

Aaron Wildavsky, one of the great policy analysts of the late twentieth century, wrote extensively about the benefits of resilient social institutions. Wildavsky observed that possible risk-reduction interventions lie along a spectrum from resilient to interceptive. Resilient approaches maximize our ability to cope with risk by maintaining a dynamic, market-based, knowledge-building strategy. Interceptive interventions emphasize specific risk-reduction efforts that require certain specific actions and prohibit or restrict others.[8] But how do we decide, for a given risk such as climate change, whether an interceptive approach is more likely to provide greater safety than a resilient approach?

Wildavsky demonstrated that uncertainties about the likelihood or extent of any given risk and about the effectiveness of any intervention constrain risk-reduction decisions.[9] Figure 4 shows how uncertainties about the nature and scope of a risk and uncertainties about intervention measures and their effects constrain strategy selection, favoring certain approaches over others.

Employing both theory and empirical observation, Wildavsky observed that a strategy of interception is likely to be successful only in situations of truly excellent information. So, for example, for a power plant owner who knows that a particular part is going to burn out every 150 days, an interception strategy of replacing the part every 149 days to prevent the risk is likely cost-effective. But where less information exists, more resilient strategies are likely to succeed because interception will be either infeasible or expensive in such situations. If a power plant had eight thousand critical pieces of equipment that would create a fire upon failure, but the plant owner did not know the failure rates of each piece, trying to intercept the risk by replacing pieces before they failed would be enormously costly. Further, trying to have backup systems on all eight thousand pieces would be technologically difficult and probably not financially feasible. Instead, a strategy of resilience, such as implementing a sophisticated fire-response system, is more likely to be a feasible and efficient way of dealing with this risk.

In the case of climate change, our knowledge of the nature and scope of risks and future conditions is low, and our knowledge about how to intervene to head off specific risks is small. This suggests that contrary to current policy approaches that focus on mitigating GHG emissions largely to the exclusion of everything else, resilience should be considered the default climate strategy. As Wildavsky observed:

- Resilient systems build knowledge through research and build safety through efficient use of resources, enhancing the ability to respond to and reduce risks over time.

- Resilient approaches optimize use of local knowledge of specific and particular circumstances. Since resources are retained by individuals and firms in the social and economic system, people will instinctively reduce risks as they perceive them.

- Resilient approaches create spillover knowledge by building knowledge at local levels that can then be brought into play in other areas. Research is a natural part of resilient systems.[10]

Wildavsky illustrates these characteristics, drawing from the work of systems ecologists Kenneth E. F. Watt and Paul Craig. In one example, Wildavsky explains why a market-based system is more stable and, therefore, safer: the complexity and intricate nature of negative and positive feedback as conveyed through a market is a powerful stabilizing force whether that market is financial or involves the way energy is distributed through an ecosystem. Natural systems exhibit this complexity and rich feedback milieu, but so do economic systems:

> Systems of great complexity, with stability maintained by a lot of fast acting negative feedback loops are complex economies, with prices responding freely to trends in supply and demand. In such circumstances, we see very rapid introduction of new products, or replacement of old by new products.[11]

In yet another example, Wildavsky points out that ecological studies present cautionary findings with regard to poor specific risk-reduction investments:

> We are specifically concerned with stability of the entire system in contradistinction to stability of each component of the system. That is, we understand that in biological, economic, or any other kind of systems, the former can be maintained at the expense of the latter. Putting this differently, if the goal adopted is to preserve stability of particular system components, the ultimate consequence can be decreased stability in the entire system.[12]

To a large extent, the resilience option is the complete opposite of the climate-stasis approach; it focuses on decentralization, deregulation, and freeing markets to maximize resilience.

Managing Risks with Resilience-Building Policies

A vast range of risks has been discussed in the context of climate change, from flood to drought, threatened food supplies, more deadly insect-borne diseases, higher heat-related deaths, rising sea levels, and so forth. The risks discussed in this *Outlook* are not future probabilities based on empirical evidence and extrapolation. Rather, they derive from computer models of potential future change and are, therefore, not to be taken as known threats but rather as hypothesized threats made using relatively primitive modeling technology subject to the garbage-in, garbage-out problem typical of the breed. The risks are discussed here with that limitation in mind, as potential risks, without any measure of probability attached. Several approaches economists and policy analysts have identified could help increase social resilience to such risks.

Contrary to current policy approaches that focus on mitigating GHG emissions largely to the exclusion of everything else, resilience should be considered the default climate strategy.

Eliminate Risk Subsidies. Predicted damages associated with sea levels and storms are high because of the popularity of such locales for high-density business and upscale residential development. As a result, damages from extreme coastal weather events have been hugely expensive. The damages from Hurricane Katrina, for example, reached over $150 billion.[13] The question, however, is why was there so much value that was so badly protected against completely predictable events? Levees and sea walls were underdesigned. Many houses and businesses were not insured against flood damage. As Charles Perrow observes in *Our Next Catastrophe*, "Even in areas known to be hazardous, only about 20 percent of homeowners purchase flood insurance, and less than 50 percent of businesses purchase flood and earthquake insurance in risky areas."[14]

The answer to that question lies, at least in part, in the presumed role of state and federal governments as the insurer of last resort. People know that in the event of a disaster, even if uninsured, the Federal Emergency Management Agency will give grants to let people recover from natural disasters such as hurricanes, floods, and storm surges. Without such assurances, we can assume that many people would be unwilling to face the risk of living in coastal areas that could be flooded by rising sea levels and would relocate to higher ground. Capital needed for businesses would also avoid areas of high risk due to sea-level rise, preventing further siting of high-value structures in vulnerable areas.

As researchers at the Wharton Risk Center observe:

> Highly subsidized premiums or premiums artificially compressed by regulations, without clear communication on the actual risk facing individuals and businesses, encourage development of hazard-prone areas in ways that are costly to both the individuals who locate there (when the disaster strikes) as well as others who are likely to incur some of the costs of bailing out victims following the next disaster (either at a state level through ex post [facto] residual market assessments or through federal taxes in the case of federal relief or tax breaks).[15]

Similarly, the CATO Institute points out:

> Government-provided programs for crop insurance and flood insurance, as well as other interventions in private disaster insurance markets, often are justified as necessary to overcome the failure of private markets to offer adequate and affordable disaster insurance. Defenders of government insurance programs claim that they reduce dependence on "free" disaster assistance and promote efficient risk management by property owners and farmers.
>
> But government policies are the cause of, not the cure for, the limited supply and narrow scope of private-sector disaster insurance. Demand for private coverage is low in part because of the availability of disaster assistance, which substitutes for both public and private insurance. Moreover, a government that cannot say no to generous disaster assistance is unlikely to implement an insurance program with strong incentives for risk management.
>
> The subsidized rates and limited underwriting and risk classification of federal government insurance programs aggravate adverse selection, discourage efficient risk management, and crowd out market-based alternatives.
>
> Federal tax policy reduces supply by substantially increasing insurers' costs of holding capital to cover very large but infrequent losses. State governments also intrude on insurance markets by capping rates, mandating supply of particular types of insurance, and creating state pools to provide catastrophe insurance or reinsurance coverage at subsidized rates. By reducing both the supply and demand sides of private insurance protection, government intervention leads to greater reliance on politically controlled disaster assistance and higher costs for taxpayers.[16]

Perrow makes the case that this is no better at the state level:

> State-mandated pools have been established to serve as a market of last resort for those unable to get insurance, but the premiums are low and thus these have the perverse effect of subsidizing those who choose to live in risky areas and imposing excess costs on people living elsewhere. In addition, the private insurers are liable for the net losses of these pools, on a market-share basis. The more insurance they sell, the larger their liability for the uninsured. Naturally, they are inclined to stop writing policies where there may be catastrophic losses (hurricanes in Florida and earthquakes in California). The Florida and California coastlines are very desirable places to live and their populations have grown rapidly, but these handsome lifestyles are subsidized by residents living in the less desirable inland areas in the state, and, to some limited extent, by everyone in the nation.[17]

If risk subsidies cannot be abolished entirely, at the very least, insurance companies should charge risk-based premiums. As Wharton researchers explain:

> Insurance premiums (whether public or private coverage) should, to the extent possible, reflect the underlying risk associated with the events against which coverage is bought in order to provide a clear signal to individuals and businesses of the dangers they face when locating in hazard-prone areas and [to] encourage them to engage in cost-effective mitigation measures to reduce their vulnerability to disasters.[18]

Privatize Infrastructure. Climate change could also pose a challenge for coastal or low-lying roadways, water-treatment facilities facing increased rainfall intensity, energy utilities facing increased summertime electricity demand, and so on. Governments are quite good at building infrastructure. After all, what politician does not enjoy a ribbon cutting ceremony for some new element of name-bearing infrastructure? But governments are dismal at maintaining infrastructure, as they generally fail to establish a revenue stream to maintain a system that provides feedback about whether a particular road should be raised or a water-treatment facility expanded or a power capability increased. A solution to these problems, as well as a potential source of revenue for cash-strapped state and municipal governments, is the privatization of infrastructure. While a few poorly executed privatization efforts have tarnished the name, the baby should not be thrown out with the bath water; privatization offers a host of benefits. A great deal of research on privatization in developing and developed countries demonstrates that, on the whole, privatization shows considerably more benefit than risk.

It has long been known that certain types of risk are not suited to attempted prevention but instead must be met with the resilience needed to live with the risk. Climate change is one such risk that is virtually impossible to prevent.

In "An Assessment of Privatization," Sunita Kikeri and John Nellis conclude that "[i]n infrastructure sectors, privatization improves welfare, a broader and crucial objective when it is accompanied by proper policy and regulatory frameworks." Further, they observe that "ownership change in productive firms, as well as private investment in less than full ownership capacity, usually improves the financial situation of the firm and the fiscal position of selling government, increases returns to shareholders, and in the right policy circumstances, generates significant welfare benefits as well."[19] Private owners of infrastructure have a lot of investment tied up in getting a long-run stream of revenue from the infrastructure. Ensuring that future changes in climate do not disrupt that long-run cash flow is critical to their current financial performance.

Roadways. If roads are privately owned and tolled, road operators have a revenue stream to tap in order to raise, resurface, or recontour roadways to adapt to climate changes. If costs of such adaptation are high, tolls will rise, and at some point, an economic decision will occur about whether a road should be maintained or whether some alternate route should be developed. In some cases, people may indeed find their transportation options so limited that they must move away to a place with a less fragile climate. One can imagine something like this for some coastal roadways where there are no easy alternate routes, but it would probably be a fairly rare outcome. Still, if such situations did develop, this is a desirable outcome, as it is both economically efficient and reduces the likely cost of climate-related damages to structures.

Electricity Supply. As long as governments distort the prices consumers pay for energy with subsidies, fuel mandates, renewable power mandates, and the like, electricity markets cannot effectively adapt to changing climatic conditions. If electricity markets were fully deregulated, and if full costs were passed onto consumers, price signals would be created for the electricity provider in terms of expanding or decreasing capacity and for the consumer in terms of the real cost of living in an environment subject to energy-consuming heat waves (or cold snaps). Privatization would create incentives for electricity conservation and for the acquisition of energy-efficient appliances and devices without any need for specific governmental efficiency standards. Further, electric companies would be driven to connect with one another to ensure reliability to their customers rather than doing the minimum possible to satisfy regulators.

Water Supply. Full pricing of water and full privatization of the water supply, drinking water plants, and wastewater treatment plants would ameliorate many climatic risks incrementally over time, including flooding, seawater intrusion, and coastal and river pollution from storm runoff. Charging the full price for water, from supply to disposal, would create a price signal for consumers regarding the real risks they face living in hydrologically sensitive areas and create incentives for conservation while producing a revenue stream to allow for expanded capability or the securing of alternative supplies. At some point, again, high prices could simply lead people to move away from areas that are hydrologically costly, such as cities dependent on a single winter snow pack that shrinks or a single major river that suffers reduced flow.

Flooding. What is not achieved by removing insurance subsidies in flood-prone areas can be managed through the creation of privately administered hydrologic utilities, which would be financed by flood-protection fees charged to residents of flood-prone areas. Again, such a system creates a price signal that can show when it is and when it is not efficient to raise the height of a levee, for example, or to expand permeable surfacing requirements in development. The cost of paying for such activities would send the consumer a signal about the true cost of living in flood-prone areas and would ultimately lead those who could not afford to fully finance their level of risk to relocate to safer areas.

Trust in Resilience, but Tie Up Your Camel

In the event that climate change does tend toward higher estimates put forward by the United Nations and other groups, it is reasonable to consider insurance options that might help deal with such climate changes. Such options might include government investment in geoengineering research, investment in research and development to advance technologies allowing the removal of GHGs from the atmosphere, and possibly the creation of a climate adaptation fund to be used when state and local governments find themselves unable to cope with a given climate change, or even to compensate others should it ultimately be shown that U.S. emissions of GHGs have caused harm to other countries or the property of other individuals.

It has long been known that certain types of risk are not suited to attempted prevention but instead must be met with the resilience needed to live with the risk. Climate change is one such risk that is, as the world is increasingly observing, virtually impossible to prevent, whether it is manmade or natural.

As efforts to mitigate GHGs fail around the world, it is long past time to broaden the tools available to us in order to make our society resilient to climate risk. Rather than remain largely focused on the quixotic effort to reduce GHG emissions or to stand athwart the stream of climate and shout "stop, enough!" we should shift the majority of our policymaking attention to an agenda of resilience building and adaptation, two areas with which governments particularly struggle. Plan B for climate resilience should consist of an aggressive program of resilience building through the elimination of risk subsidies and the privatization of infrastructure. Other subsidies and regulations that make the overall economy more brittle in the face of climate change would also be ripe targets for removal, such as those which permeate energy and water markets.

The author would like to acknowledge the assistance of Dharana Rijal in producing this Outlook.

Notes

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5. Steven F. Hayward and Kenneth P. Green, "Waxman-Markey: An Exercise in Unreality," AEI *Energy and Environment Outlook*, no. 3 (July 2009), available at www.aei.org/outlook/100057.

6. It is possible that per-capita CO_2 emissions were never this low even before the advent of widespread use of fossil fuels: wood burning by Americans in the nineteenth century may have produced more than 2.4 tons of CO_2 per capita. Much depends on the emissions coefficient for wood burning and how, since wood is biomass rather than a fossil fuel, reforestation is credited in carbon accounting. In 1875, burning wood generated twice as much energy as fossil fuels.

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17. Charles Perrow, *The Next Catastrophe: Reducing Our Vulnerabilities to Natural, Industrial, and Terrorist Disasters*, 38–39.

18. Erwann O. Michel-Kerjan, "Disasters and Public Policy: Can Market Lessons Help Address Government Failures?"

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Countering Kerry's Catastrophic Climate Claims

By Kenneth P. Green

On November 10, 2009, Kenneth P. Green was invited to testify before the Senate Committee on Finance about global warming. A summary of his testimony appears on the next page. During the course of his testimony, Senator John Kerry (D-Mass.) asked Green a number of questions about the science of global warming. His responses are printed here.

Not One Peer-Reviewed Paper Contradicts the "Consensus" View of the Climate Crisis

Kerry asserted that not one peer-reviewed paper contradicts the "consensus" view that greenhouse gas emissions will cause devastating consequences, and that we must limit their emissions radically to avoid the maximum "consensus" value of two degrees Celsius, which Kerry claimed was the point at which catastrophic damage would occur to the Earth's climate. I offered to provide several.

Perhaps the central issue in climate science involves estimates of the sensitivity of the climate to anthropogenic greenhouse gas emissions. Sensitivity refers to just how much warming results from an increased concentration of greenhouse gases in the atmosphere. The following papers demonstrate that the climate's sensitivity to greenhouse gases may be considerably lower than the Intergovernmental Panel on Climate Change (IPCC) claims—so much lower, in fact, that the warming we would expect from doubling the amount of CO_2 in the atmosphere would be quite modest (well below two degrees Celsius) and offer very little risk. Do these papers truly reflect the reality of how the climate works? Perhaps they do, perhaps they do not, but it cannot be argued that they do not exist.

In a recently published article, Richard S. Lindzen and Yong-Sang Choi[1] use data from NASA's Earth Radiation Budget Experiment to assess the climate's sensitivity to greenhouse gases. In this article, they demonstrate empirically that the climate sensitivity to a doubling of greenhouse gases is only about 0.5 degrees Celsius, one-sixth of the IPCC estimate of 3 degrees Celsius.

Another study by Roy W. Spencer and William D. Braswell[2] also examines the data from NASA's Clouds and the Earth's Radiant Energy System satellites. It concludes that "eight years of the latest NASA satellite measurements of variations in both the Earth's radiative budget, and in lower atmospheric temperature, suggest two important conclusions related to the global warming issue. The first is that the sensitivity of the climate system is much lower than the IPCC climate models suggest; that is, the climate system is dominated by negative feedbacks." Spencer and Braswell also conclude that "taken together, these results suggest that the IPCC's claim that global warming is mostly man-made is, at best, premature."

A study by Nicola Scafetta and Richard C. Willson[3] examines data regarding changes in total solar irradiance (TSI), concluding: "This finding has evident repercussions for climate change and solar physics. Increasing TSI between 1980 and 2000 could have contributed significantly to global warming during the last three

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Kenneth P. Green (kgreen@aei.org) is a resident scholar at AEI.

1150 Seventeenth Street, N.W., Washington, D.C. 20036 202.862.5800 www.aei.org

decades. . . . Current climate models . . . have assumed that the TSI did not vary significantly during the last 30 years and have therefore underestimated the solar contribution and overestimated the anthropogenic contribution to global warming." If the warming of the last three decades has been driven by increases in solar output, it cannot also have been driven by human greenhouse gas emissions. This suggests that anthropogenic greenhouse gases have a low sensitivity value.

After studying satellite and radiosonde (weather balloon) data, **John D. McLean, Chris R. de Freitas, and Robert M. Carter**[4] concluded that ocean patterns dominate climate change in the tropics. They write, "Overall the results suggest that the Southern Oscillation exercises a consistently dominant influence on mean global temperature, with a maximum effect in the tropics, except for periods when equatorial volcanism causes ad hoc cooling. That mean global tropospheric temperature has for the last 50 years fallen and risen in close accord with the SOI [Southern Oscillation Index] of 5–7 months earlier shows the potential of natural forcing mechanisms to account for most of the temperature variation."

In another study, Petr Chylek and Ulrike Lohmann[5] "use the temperature, carbon dioxide, methane, and dust concentration record from the Vostok ice core to deduce the aerosol radiative forcing during the Last Glacial Maximum to Holocene transition and the climate sensitivity." Their research "suggests a 95% likelihood of warming between 1.3 and 2.3 K due to doubling of atmospheric concentration of CO_2." (A degree Kelvin [K] is equal to a degree Celsius [C].) These values are considerably lower than the sensitivity values estimated by the IPCC.

In another study,[6] the authors use satellite and surface temperature observations to study the effect of aerosols on climate and to examine climate sensitivity. They find "that the climate sensitivity is reduced by at least a factor of 2 when direct and indirect effects of decreasing aerosols are included, compared to the case where the radiative forcing is ascribed

Key Points from Kenneth P. Green's Testimony before the Senate Committee on Finance:

1. Cap-and-trade is an inappropriate mechanism for the control of greenhouse gases. I observed that this was not only my opinion, but also that of the economists who first developed the concept, as well as people like James Hansen and the organization Earth First!, neither of which are known to dismiss climate change as a problem. I have subsequently learned that Greenpeace also opposes cap-and-trade as a mechanism for controlling greenhouse gases.

2. Cap-and-trade will fail to control carbon emissions because of inevitable corruptions of the scheme in the political process and afterward in trading markets.

3. Cap-and-trade will, however, cap economic growth, as every time the economy grows, we use more energy, which will increase permit prices, eventually stifling growth.

4. Higher energy prices will increase the costs of goods and services, suppressing demand and killing jobs.

5. Higher energy prices will make American industry less competitive, leading to industry flight and more lost jobs, unless we wish to return to the days of tariff wars and unfree trade.

6. Current cap-and-trade legislation will cause economic winners and losers both regionally and sectorally across the United States, often unjustly transferring money from poorer communities to more wealthy communities.

7. Cap-and-trade will create a new class of poorly understood financial instruments that risk creating a bubble far larger than the one that recently knocked the economy into a deep recession.

8. By favoring biofuels, cap-and-trade will put a bounty on ecosystems and lead to massive conversion of forests and prairies into biofuel plantations.

9. The idea that current legislation can be described as a "jobs bill" is ludicrous. One hundred and fifty years of economics tells us that governments do not create jobs; they just move them around, invariably killing more than they create.

only to increases in atmospheric concentrations of carbon dioxide."

Sherwood B. Idso[7] reviews various "natural experiments" that can reveal how sensitive the climate is to increasing concentrations of greenhouse gases and concludes: "Over the course of the past 2 decades, I have analyzed a number of natural phenomena that reveal how Earth's near-surface air temperature responds to surface radiative perturbations. These studies all suggest that a 300 to 600 ppm [parts per million] doubling of the atmosphere's CO_2 concentration could raise the planet's mean surface air temperature by only about 0.4°C. Even this modicum of warming may never be realized, however, for it could be negated by a number of planetary cooling forces that are intensified by warmer temperatures and by the strengthening of biological processes that are enhanced by the same rise in atmospheric CO_2 concentration that drives the warming. Several of these cooling forces have individually been estimated to be of equivalent magnitude, but of opposite sign, to the typically predicted greenhouse effect of a doubling of the air's CO_2 content, which suggests to me that little net temperature change will ultimately result from the ongoing buildup of CO_2 in Earth's atmosphere."

Many other studies challenging various elements of the "consensus" that anthropogenic greenhouse gases are causing, or will cause, catastrophic climate change can be found at the website www.populartechnology.net, which boasts 450 peer-reviewed publications challenging different elements of the "climate crisis" paradigm that both Kerry and former vice president Al Gore wholeheartedly endorse.

Ice-Free Arctic by 2013

When I mentioned that the claims that we would see an ice-free Arctic by 2013 had been withdrawn, Kerry asked for documentation. I offered to provide some. There is considerable controversy over the claim of an ice-free Arctic by 2013, as can be seen in the following articles:

In an article by Jonathan Amos,[8] other Arctic ice researchers refute the assertion that an ice-free Arctic is likely by 2013. The article quotes Mark Serreze, a research scientist with the U.S. National Snow and Ice Data Center, saying, "A few years ago, even I was thinking 2050, 2070, out beyond the year 2100, because that's what our models were telling us. But as we've seen, the models aren't fast enough right now; we are losing ice at a much more rapid rate. My thinking on this is that 2030 is not an unreasonable date to be thinking of." Serreze also told the BBC that Wieslaw Maslowski, the climate scientist who announced that Arctic summers could be ice free by 2013, "is probably a little aggressive in his projections, simply because the luck of the draw means natural variability can kick in to give you a few years in which the ice loss is a little less than you've had in previous years."

> The climate's sensitivity to greenhouse gases is considerably lower than the Intergovernmental Panel on Climate Change claims—so much lower, in fact, that the warming we would expect from doubling the amount of CO_2 in the atmosphere would be quite modest and offer very little risk.

An article by David Adam quotes[9] Vicky Pope, the head of climate change advice at the British Met Office Hadley Centre, saying that "there is little evidence to support claims that Arctic ice has reached a tipping point and could disappear within a decade or so, as some reports have suggested." The article states that "summer ice extent in the Arctic, formed by frozen sea water, has collapsed in recent years," and notes that the amount of ice in September of last year was 34 percent lower than the average amount of ice present since satellite measurements began in 1979. Pope says, "The record-breaking losses in the past couple of years could easily be due to natural fluctuations in the weather, with summer ice increasing again over the next few years." She goes on to say, "It is easy for scientists to grab attention by linking climate change to the latest extreme weather event or apocalyptic prediction. But in doing so, the public perception of climate change can be distorted. The reality is that extreme events arise when natural variations in the weather and climate combine with long-term climate change."

According to the British Met Office,[10] the 2007 Arctic ice-melt was an anomaly unrelated to climate change. The article says, "Modeling of Arctic sea ice by the Met Office Hadley Centre climate model shows that ice invariably recovers from extreme events, and that the long-term trend of reduction is robust—with the first ice-free summer expected to occur between 2060 and 2080. It is unlikely that the Arctic will experience ice-free summers by 2020."

Peer-Reviewed Publishing?

Finally, Kerry seemed to think it somehow damning that I do not choose to publish in the peer-reviewed climate literature. First—as I pointed out when I introduced myself—while I am an environmental scientist by training, I have chosen to work on policy analysis, which I believe is as important as, or more important than, the science.

However, I would challenge the very premise Kerry makes, which is that peer review is a meaningful indicator of trustworthiness. Plenty of research suggests that peer review is deeply flawed, biased in favor of both extreme and "positive" claims, resistant to nonconfirmation studies, and highly incestuous because review committees regularly screen out divergent viewpoints and consist of peers who coauthor work with each other. While most research on problems with peer review involves medical literature, there is every reason to believe the same problems plague climate research.

As Drummond Rennie, M.D., deputy editor (West) of the *Journal of the American Medical Association*, writes, "There seems to be no study too fragmented, no hypothesis too trivial, no literature too biased or too egotistical, no design too warped, no methodology too bungled, no presentation of results too inaccurate, too obscure, and too contradictory, no analysis too self-serving, no argument too circular, no conclusions too trifling or too unjustified, and no grammar and syntax too offensive for a paper to end up in print."[11] Peer review determines where rather than whether a paper should be published, Rennie says. However, from time to time, "shoddy science" ends up even in the most prestigious journals.

Examining peer review in the context of genetically modified food, Richard Horton, editor of the medical journal *The Lancet*, has observed that "the mistake, of course, is to have thought that peer review was any more than a crude means of discovering the acceptability—not the validity—of a new finding. Editors and scientists alike insist on the pivotal importance of peer review. We portray peer review to the public as a quasi-sacred process that helps to make science our most objective truth teller. But we know that the system of peer review is biased, unjust, unaccountable, incomplete, easily fixed, often insulting, usually ignorant, occasionally foolish, and frequently wrong."[12]

For additional information on the limitations of peer review, I point you to the following papers:

John P. A. Ioannidis,[13] examines the various elements that can lead to studies being published in peer-reviewed literature despite failing to accurately represent reality, and concludes that "most research findings are false for most research designs and for most fields."

Plenty of research suggests that peer review is deeply flawed, biased in favor of both extreme and "positive" claims, resistant to nonconfirmation studies, and highly incestuous.

Neal S. Young, John P. A. Ioannidis, and Omar Al-Ubaydli[14] examine current publication practices in an economic framework and conclude: "The current system of publication in biomedical research provides a distorted view of the reality of scientific data that are generated in the laboratory and clinic. This system can be studied by applying principles from the field of economics. The winner's curse, a more general statement of publication bias, suggests that the small proportion of results chosen for publication are unrepresentative of scientists' repeated samplings of the real world. The self-correcting mechanism in science is retarded by the extreme imbalance between the abundance of supply (the output of basic science laboratories and clinical investigations) and the increasingly limited venues for publication (journals with sufficiently high impact)." As an example, they point out that "an empirical evaluation of the 49 most-cited papers on the effectiveness of medical interventions, published in highly visible journals in 1990–2004, showed that a quarter of the randomised trials and five of six non-randomised studies had already been contradicted or found to have been exaggerated by 2005. The delay between the reporting of an initial positive study and subsequent publication of concurrently performed but negative results is measured in years."

Jeffrey D. Scargle[15] has studied what is called the "file-drawer" problem in scientific research. That is, if a laboratory runs one hundred experiments that obtain a negative result and only one that reaches a positive result (which can happen by chance), the laboratory can simply publish the one study and relegate the others to the file drawer or trash can. The authors conclude: "Publication bias arises whenever the probability that a study is published depends on the statistical significance of its results. This bias, often called the file-drawer effect because the unpublished results are imagined to be tucked away in researchers' file cabinets, is a potentially severe impediment to combining the statistical results of studies collected from the literature. With almost any reasonable quantitative model for publication bias, only a small number of studies lost in the file drawer will produce a significant bias."

In a study of articles from *Nature* and the *British Medical Journal* (*BMJ*), **Emili García-Berthou and Carles Alcaraz**[16] looked for erroneous statistics. They found that "at least one such error appeared in 38% and 25% of the papers of *Nature* and *BMJ*, respectively. In 12% of the cases, the significance level might change one or more orders of magnitude."

In a column by David F. Horrobin,[17] the longtime critic of peer review observes that "far from filtering out junk science, peer review may be blocking the flow of innovation and corrupting public support of science."

For a specific example of the incest problem in climate research, see **the report to Congress prepared by Edward J. Wegman, David W. Scott, and Yasmin H. Said.**[18] In this report, solicited by Congress itself, leading statistician Wegman and colleagues were asked to study claims disputing the iconic "hockey stick" chart famously produced by Michael Mann at the University of Virginia. The "hockey stick" is a "reconstruction" of global average temperatures stretching far into the past (over one thousand years) that shows a relatively smooth decline in temperatures over that time until about 1900, at which time temperatures appear to increase sharply. Not only did the Wegman panel uphold criticisms of that chart, it found improprieties in the review process: "In particular, if there is a tight relationship among the authors and there are [*sic*] not a large number of individuals engaged in a particular topic area, then one may suspect that the peer review process does not fully vet papers before they are published. Indeed, a common practice among associate editors for scholarly journals is to look in the list of references for a submitted paper to see who else is writing in a given area and thus who might legitimately be called on to provide knowledgeable peer review. Of course, if a given discipline area is small and the authors in the area are tightly coupled, then this process is likely to turn up very sympathetic referees. These referees may have coauthored other papers with a given author. They may believe they know that author's other writings well enough that errors can continue to propagate and indeed be reinforced."

There are strong suggestions that the researchers at the Climatic Research Unit, along with their colleagues elsewhere, actively sought to prevent contrary findings from being published in the peer-reviewed literature.

Wegman, Scott, and Said then set to examine whether or not such close relationships existed in the paleoclimate community, and they note that "in our further exploration of the social network of authorships in temperature reconstruction, we found that at least 43 authors have direct ties to Dr. Mann by virtue of coauthored papers with him. Our findings from this analysis suggest that authors in the area of paleoclimate studies are closely connected and thus 'independent studies' may not be as independent as they might appear on the surface."

Such incestuous relationships almost certainly also exist in other subcommunities of climate research, including predictive modeling, climate sensitivity estimation, greenhouse gas residence times, dendroclimatology, and more.

The existence of such "tribalism" in climate science has recently been thrown into stark relief by the public release of a vast quantity of files and e-mails that were either taken from the computer system of the University of East Anglia by hackers or posted to the Internet by a whistle-blower. The University of East Anglia is home to the Climatic Research Unit, until recently considered one of the most important climate research institutions in the world, and is a supplier of information to the IPCC.

More than one thousand e-mails and two thousand other documents were posted to the Internet; it will likely take months to fully explore the archives, and verifying the authenticity of individual documents may be impossible.[19] But from early inspection, there are strong suggestions that the researchers at the Climatic Research Unit, along with their colleagues elsewhere, actively sought to prevent contrary findings from being published in the peer-reviewed literature.

Here are some examples:

From: Tom Wigley, January 20, 2005. If you think that [James E.] Saiers is in the greenhouse skeptics camp, then, if we can find documentary evidence of this, we could go through official AGU [American Geophysical Union] channels to get him ousted.[20] [Author's note: Saiers, the editor of *Geophysical Research Letters*, was later ousted.]

From: Michael E. Mann, March 11, 2003. This was the danger of always criticising the skeptics for not publishing in the "peer-reviewed literature." Obviously, they found a solution to that—take over a journal! So what do we do about this? I think we have to stop considering "Climate Research" as a legitimate peer-reviewed journal. Perhaps we should encourage our colleagues in the climate research community to no longer submit to, or cite papers in, this journal. We would also need to consider what we tell or request of our more reasonable colleagues who currently sit on the editorial board.[21]

From: Edward Cook, June 4, 2003. I got a paper to review (submitted to the *Journal of Agricultural, Biological, and Environmental Sciences*), written by a Korean guy and someone from Berkeley, that claims that the method of reconstruction that we use in dendroclimatology (reverse regression) is wrong, biased, lousy, horrible, etc. They use your Tornetrask recon as the main whipping boy. . . . If published as is, this paper could really do some damage. It is also an ugly paper to review because it is rather mathematical, with a lot of Box-Jenkins stuff in it. It won't be easy to dismiss out of hand as the math appears to be correct theoretically. . . . I am really sorry but I have to nag about that review—Confidentially I now need a hard and if required extensive case for rejecting—to support Dave Stahle's and really as soon as you can. Please.[22]

From: Tom Wigley, April 24, 2003. Mike's idea to get editorial board members to resign will probably not work—must get rid of [Hans] von Storch too, otherwise holes will eventually fill up with people like [David R.] Legates, [Robert C.] Balling, [Richard S.] Lindzen, [Patrick J.] Michaels, [S. Fred] Singer, etc. I have heard that the publishers are not happy with von Storch, so the above approach might remove that hurdle too.[23]

From: Phil Jones, July 8, 2004. I can't see either of these papers being in the next IPCC report. Kevin and I will keep them out somehow—even if we have to redefine what the peer-review literature is![24]

Finally, Kerry implied that I had not said what I would do about the risk of climate change. This is incorrect. In my response to him, and other members of the committee, I offered to provide my latest paper on adaptation to the committee.[25] The summary is as follows: "The Earth's climate is prone to sharp changes over fairly short periods of time. Plans that focus simply on stopping climate change are unlikely to succeed; fluctuations in the Earth's climate predate humanity. Rather than try to make the climate static, policymakers should focus on implementing resilience strategies to enable adaptation to a dynamic, changing climate. Resilience strategies can be successful if we eliminate current risk subsidies and privatize infrastructure."

Notes

1. Richard S. Lindzen and Yong-Sang Choi, "On the Determination of Climate Feedbacks from ERBE Data," *Geophysical Research Letters* 36, no. 16 (August 2009).
2. Roy W. Spencer and William D. Braswell, "Potential Biases in Feedback Diagnosis from Observations Data: A Simple Model Demonstration," *Journal of Climate* 21 (November 2008): 5,624–28.
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AEI American Enterprise Institute for Public Policy Research

Senate Finance Committee
Climate Change Legislation: Considerations for Future Jobs
November 10, 2009

Responses to Questions for Dr. Kenneth Green, Resident Scholar,
American Enterprise Institute for Public Policy Research

Questions from Senator Baucus

QUESTION: Your testimony says, "For emission trading to work, you need readily available technology to capture emissions, or alternative sources of energy that lets some people generate surplus emission reductions so they can sell them to others. We had that with SO2: we don't have that with CO2."

Isn't it true that with SO2 the only options available for emissions cuts were scrubbers and low-sulfur coal? Isn't it also true that there are several options for cutting carbon emissions, on the demand-side and the supply-side? Aren't these technologies critical to avoiding contraction and preserving jobs in the coal sector?

ANSWER: It is true that with SO2, the primary options available were scrubbers, and low-sulfur coal. Another option was to switch from coal to natural gas power, but to my knowledge that was not a significant pathway to compliance. What is most significant in the difference between SO2 control and CO2 control is the cost of the equipment. Scrubbers were quite inexpensive, and low-sulfur coal was no more expensive than higher-sulfur coal. This is not the case with regard to CO2: capturing carbon dioxide requires a lot of energy, and there's no such thing as "Low-carbon coal."

And yes, it is true that there are options for cutting carbon emissions on both the demand-side and the supply-side. Such options could include reducing consumer demand through carbon pricing and various appliance performance standards, improving the efficiency of power plants, and carbon capture and storage. The problem with these approaches, as I mentioned in my testimony, is that they are costly, would cause economic damage and job loss, and in the case of carbon capture and storage, they are possibly illusory. In an editorial I published in Canada's Financial Post, I pointed out:

"Let's review the problems with the idea of carbon capture and storage (CCS), which make it unlikely as an environmental savior. Land-based CCS consists of three primary activities: capturing carbon dioxide out of an emissions stream, compressing it into a liquid, and then piping that liquid over land, and down into the Earth where, in theory, it will be retained in geological formations for hundreds or thousands of years. It sounds quite simple, until you dig into the details.

First, there's the difficulty of capturing carbon dioxide. One of the reasons that CO2 is so difficult to deal with is that it's an extremely stable molecule, one that isn't easily bound to other substances. In fact, binding up carbon dioxide takes quite a lot of energy. Estimates suggest that capturing carbon from a conventional coal-fired power plant, for example, could consume up to 40% of the plant's total power output. The technology isn't exactly cheap, either: the U.S. Department of Energy estimates that adding CCS technology to power plants would double their costs, raising energy rates by 21% to 91%.

Second, transporting the bulk of CO2 that would have to be stored is no small feat. When fossil fuels are burned, the carbon atoms that make up the fuel are bound to two oxygen atoms. As a result, the mass of the CO2 emissions are considerably greater than the mass of the original fuel. For example, if you burn one ton of coal that has a carbon content of 78%, you wind up producing almost three tons of carbon dioxide. If one has to transport that mass any significant distance to bury it, the infrastructure costs become a problem. One estimate, made by Australia's Commonwealth Scientific and Research Organization, suggests that the transport component of CCS becomes cost-prohibitive if the distance to the point of burial exceeds 100 kilometres.

Third, there are questions of both durability and safety: What is put underground does not always stay underground. And in the case of CO2, which is 1.5 times denser than air, the consequences of large scale leaks can be devastating.

QUESTION: Several news recent reports indicate that China is making great strides in the development and manufacture of clean-energy technology. An August 2009 Christian Science Monitor article notes that Chinese factories already make a third of the world's solar cells – six times more than the U.S., and that last year China graduated 17 PhDs in the field of underground coal gasification, while only two others graduated in the rest of the world.

Please comment on China's green technology developments and the impact these will have on green technology and jobs in the United States. Please also share your thoughts on the U.S.'s opportunity to engage in similar technology development and job creation, such as through incentives like the new advanced energy manufacturing credit Congress passed in February.

ANSWER: China is "blessed" with several things which make their costs for building and deploying wind and solar power that the United States is not. First, China has very low cost labor, which operates under far fewer worker health and safety regulations than do workers in the United States. This makes manufacture of both materials and completed systems considerably less expensive than it would be here. Also, China is a totalitarian regime that does not have to worry about things like local resistance to siting of wind or solar plants, nor are they subject to challenges by environmental groups. They also have the luxury of simply displacing large parts of their population when they want to build new infrastructure, as was vividly demonstrated in their treatment of peasant farmers during the building of their Three Gorges Dam.

As a policy analyst who favors Austrian economics, it is my belief that the best thing to do is let the market function. If it is more efficient to build renewable energy generators in China, and if we can buy them from China for less than it costs us to produce them, then that's what we should do. Unless we are willing to dismantle many of the regulations that make us non-competitive, trying to compete with China in the production of labor-intensive goods is likely to be a fool's errand. Where we can (and do) compete is in the creation of these new technologies, and for that to continue, China's tendency to ignore intellectual property rights must be addressed, and plans to "transfer" such technologies to China for free under an international framework must be avoided. Increasing availability for grant and loan support to the engineering departments of our major universities would also be a reasonable approach to preserving our ability to compete in the product-development phase of the process.

As for the impact that China's production of windmills and solar systems will have on American jobs, to the extent that we deploy higher-cost forms of energy production, and raise the costs of energy here in the United States, the less competitive we will make ourselves, the slower our economy will be, and the more jobs we will lose. There is much talk about this next great wave of "green energy," but I, along with others, believe that this is just more bubble-mentality speculation.

Questions from Senator Cantwell

QUESTION: In addition to thinking about the costs of policy action on climate change, we need to be just as aware of the potential costs of inaction. There is going to be tremendous energy growth, particularly in the developing world, over the next century. Energy is already a $6 trillion market, and it is growing fast. I want to be sure that the United States is the world's leading supplier of clean energy technologies to meet the exploding world demand.

How should policymakers create and structure incentives that enable US leadership in clean energy technologies? Is a consistent, stable price on fossil carbon an effective or necessary component?

ANSWER: As a policy analyst who favors Austrian economics, it is my belief that the best thing to do is let the market function. If it is more efficient to build renewable energy generators in China, and if we can buy them from China for less than it costs us to produce them, then that's what we should do. Unless we are willing to dismantle many of the regulations that make us non-competitive, trying to compete with China in the production of labor-intensive goods is likely to be a fool's errand. Where we can (and do) compete is in the creation of these new technologies, and for that to continue, China's tendency to ignore intellectual property rights must be addressed, and plans to "transfer" such technologies to China for free under an international framework must be avoided. Increasing availability for grant and loan support to the engineering departments of our major universities would also be a reasonable approach to preserving our ability to compete in the product-development phase of the process.

Putting a price on carbon emissions would make renewable energy more competitive against coal, and natural gas power, and would, therefore, stimulate demand for wind turbines and solar panels. Unfortunately, unless we are willing to abandon free-trade, the majority of those devices will be made where labor costs and regulatory burdens are low. Should we somehow manage to keep production of wind turbines and solar panels in the United States through subsidization, all we would accomplish is to pay more for tomorrow's renewable energy than we would if we simply purchased the finished products from China.

QUESTION: How do you think we should balance the protection of existing industries with the promotion of future industries? Isn't there a real risk that if we fail to create the right investment incentives at home, we may miss out on the lucrative opportunities that will accompany global leadership in clean energy?

ANSWER: As a believer in Austrian economics, I think that the best thing government can do to maximize employment in the United States is to create the conditions under which businesses and entrepreneurs can thrive. It is not the government's role to decide what those jobs are, nor what they pay, nor has the government shown any facility in picking which technologies are likely to be winners, and which to be losers. There is in deed a risk that we will miss out on some opportunities in clean energy, but there's an equal (or larger) chance that we'll miss out on a lot of failed clean energy efforts, and outright "clean energy" boondoggles. If we wish to stimulate job growth in the United States, we know what needs to be done: regulatory streamlining; reform of the tax system; and relaxation or removal of the uncountable regulations that inflate our labor and product costs; and increased production of ***low-cost*** energy.

QUESTION: One of the most important ways we can stimulate economic growth and job creation through climate policy is by creating consistent price signals and long-term incentives for investment in innovation and new energy technologies.

In any policy involving the auctioning of emissions allowances, do you think that price controls—both price floors and ceilings—are necessary to manage volatility and uncertainty?

ANSWER: Though as I mentioned in my testimony, I am not a fan of using cap-and-trade to control greenhouse gas emissions, I would agree with you that a strong price collar would be necessary to manage volatility, and uncertainty in the deployment of lower-carbon energy sources. It's important in such a case that the collar not spread out over time, but rather, be tightly constrained at all points in the future.

QUESTION: Would a well-designed, price collar (i.e. explicit upper and lower bounds for the price of allowances) provide sufficient assurances for substantial investment in capital-intensive, low-carbon energy systems such as CCS and nuclear, as well as other, more conventional

ANSWER: This is an important question, but it's also one that is difficult to answer, as it will depend on certain things we can't really predict. If the price of carbon allowances is high-enough to render low-carbon energy systems compatible, then yes, it would probably create incentives for investment in such technologies. But if for some reason, due to offset purchases or other unknowns, the permit price stays relatively low. Then low-carbon energy may remain non-competitive.

QUESTION: You have made a case in your work for a revenue-neutral carbon tax. But I don't see how a carbon tax solves some of the problems of cap-and-trade, such as carbon leakage and overall environmental effectiveness.

ANSWER: You're correct, a carbon tax is not a panacea. As I have written, and talked about in various venues, a revenue neutral carbon tax (RNCT) does leave one with the problem of leakage. Any effort to price carbon in the United States that is not matched internationally will lead to leakage unless counter-measures are put in place such as border adjustments. Such tariffs, however, will undoubtedly trigger counter-tariffs, moving the world back away from the free-trade that has caused such massive gains in wealth over the 20th Century, and that is needed more than ever in the 21st Century. This is why, when I talk about near term mitigation I explain that an RNCT "is better than" an emission-trading approach, but I would not impose either one on their own merits. I do not believe they will offer us an environmental benefit, while I believe that they will reduce U.S. competitiveness, send jobs and businesses abroad, cause economic contraction, and consequent job losses.

QUESTION: How can we be sure we'll achieve emissions certainty without a firm cap—one that is not dependent on allowance giveaways or huge quantities of offsets? Would a well-designed price collar with an upstream cap function more like the carbon tax you have advocated?

ANSWER: We can't actually be sure we'll achieve emissions certainty either way. As we've seen from the EU, when prices start to bite, governments tend to exempt various sectors, undermining the effectiveness of the cap. The U.S., ad a democracy, is just as susceptible to such exemptions as are European democracies.

That being said, yes, a permit system that auctions all permits upstream, and rebates revenues to taxpayers uniformly would come as close to an RNCT as is likely possible with a quantity-based control approach.

QUESTION: How do suggest minimizing carbon leakage? What is the best approach for border equalization measures if they are necessary to protect domestic industries from unfair market prices?

ANSWER: At the risk of seeming flippant, the best way to minimize carbon leakage is to avoid making U.S. businesses unable to compete while manufacturing their products at home. That means keeping energy prices low, streamlining our ever-exploding regulatory system, opening access to low-cost domestic energy sources, and in general, doing what we can to get the economy back on its feet. I do not advocate a return to the days of less-free trade, with countries bullying other countries to adopt certain environmental policies through tariffs and "border equalization measures." You can be quite sure that if we slap such measures on Chinese imports, they will retaliate. Ultimately, all that limiting trade does is give consumers less choice, while taking away the competition that keeps our own industries from overcharging for inferior goods and services. Carbon leakage, like industry leakage, is an inevitable consequence when a country unilaterally takes steps to price carbon when others do not.

Questions from Senator Menendez

QUESTION: The European Environment Agency reports that the EU-15 has not only met their Kyoto reduction targets, but exceeded them. These reductions were already well on their way to being achieved before the current economic downturn. This means that their robust emissions-trading policy is working.

What makes this example even more compelling is the fact that the United States, which is experiencing a comparable economic downturn to the European Union, has emissions that are still well above the 1990 levels. If we hope to achieve similar success in lowering emissions it only stands to reason that we should pursue a system which is modeled after the European Trading System. (A system that in turn was modeled after our own successful acid rain program.)

How can you claim that the European Trading System (ETS) is a failure, when it has achieved such dramatic emission reductions?

ANSWER: While the ETS may have helped bring down emissions, it has done so at a cost that is higher than its benefits. That is the definition of a failed public policy. As the British Taxpayer's Alliance reports (http://www.taxpayersalliance.com/ets.pdf):

This report presents new evidence that the European Union Emissions Trading Scheme (ETS) has failed to perform and is imposing serious costs on ordinary families. The main effect of the Scheme is to increase the cost of energy for households, businesses and other organisations. This increases household bills, but also increases business running costs and the cost of running public services such as hospitals. The burden on consumers since the scheme was introduced on 1 January 2005 has been significant:

- We estimate that the ETS cost British consumers nearly £3 billion in 2008,
- equivalent to around £117 per family, by increasing the cost of energy. From its introduction to the end of 2008, we estimate that the scheme has cost consumers across Europe between €46 billion (£33 billion) and €116 billion (£83 billion). Our central estimate is that the scheme has cost consumers €93 billion (£67 billion). That is equivalent to around €185 (£132) for every person in the ETS participating countries. That is despite the emissions price having collapsed several times for prolonged periods.
- The report also presents estimates of the cost to consumers in every country participating in the scheme, in each year of the scheme's operation.
- The British Government has not just accepted this significant burden on consumers, but has actively worked to increase it. Despite continuing rhetoric about reducing fuel poverty, the Government in fact used taxpayers' money to assist the European

- Commission in legal attempts at the European Court of Justice to forcibly reduce the supply of emissions allowances and thereby increase the emissions price further. The Treasury Solicitor's Office, responding to a TaxPayers' Alliance Freedom of Information request, has revealed the amount spent on two recent cases, both of which the Commission and the British Government lost: The cost of the Government's intervention in T-183/07 Poland v Commission was £30,698.10. The cost of the Government's intervention in T-263/07 Estonia v Commission was £12,201.59.

The report also looks at other problems with the design and operation of the scheme:

- The emissions price has been very volatile, collapsing by a third or more several times since the ETS was introduced. That makes it harder for businesses and families to plan and forces them to provide for more frequent swings in their energy costs; the financial cost of the scheme to consumers is compounded by its high volatility. That high volatility also undermines the effectiveness of the scheme. Volatility in the price is likely to prove an enduring feature of the ETS carbon market.
- As the ETS pushes up electricity prices, it imposes the greatest burden on the poor and elderly, who spend the highest proportion of their income on electricity. And, on manufacturing industries where energy costs are a substantial portion of their total production costs. Energy firms make substantial windfall profits, even in competitive energy markets. Even when permits are auctioned, the scheme is still a highly regressive tax.
- The design of the scheme means that it doesn't balance the costs and benefits of cutting emissions, and can impose a massively disproportionate burden on consumers if the cost of cutting emissions is found to be higher than those managing the scheme expect. The price is already higher than many social cost estimates from prominent academics like William Nordhaus and surveys of the academic literature.

The ETS has also been plagued by fraudulent offset schemes. According to a recent article in Britain's Telegraph, "Carbon trading fraudsters may have accounted for up to 90% of all market activity in some European countries, with criminals pocketing an estimated €5bn (£4.5bn) mainly in Britain, France, Spain, Denmark and Holland, according to Europol, the European law enforcement agency. (http://www.telegraph.co.uk/earth/copenhagen-climate-change-confe/6778003/Copenhagen-climate-summit-Carbon-trading-fraudsters-in-Europe-pocket-5bn.html)

Finally, it is questionable whether the ETS was responsible for Europe's emission reductions, or whether their recession was the primary cause of their emission declines in recent years.

As an October 2009 report in the *Economist* points out, "Britain's headline figures are fairly impressive. Its greenhouse-gas emissions have fallen by 15% since 1990—comfortably inside its target under the Kyoto protocol—compared with a 2% drop in the EU as a whole and a 14% rise in America. ***Most of the decline in Britain, however, is the result not of a big policy effort but of the "dash for gas"—the move away from coal-fired power stations that followed the end of coal mining.*** The decline has now almost stopped. Emissions are falling by less than a percentage point a year, and the government has admitted that it will fail to meet a self-imposed target of a 20% reduction in carbon-dioxide emissions on 1990 levels by next year, even though

the recession has cut economic activity. Policy, in other words, is not driving emissions reductions." (emphasis mine)
(http://www.economist.com/opinion/displaystory.cfm?story_id=14649098)

The most optimistic report attributes only half of the reductions in 2008 to the ETS, with the recession causing the other half. (http://greeninc.blogs.nytimes.com/2009/04/01/recession-cuts-europes-carbon-emissions/)

Questions from Senator Cornyn

QUESTION: In your testimony, you mention that governments don't create jobs but rather shift them around. Can you elaborate on the costs governments who have adopted caps on greenhouse gases experienced? How many conventional jobs were lost and how many green jobs replaced them in these cases?

ANSWER: A study by Gabriel Calzada Álvarez and colleagues at Spain's Universidad Rey Juan Carlos is highly illustrative. After studying Spain's aggressive wind power program - a program hailed by President Obama himself as a good example of what can be done in the U.S. – the researchers concluded that based on Spain's experience, for every renewable energy job that the U.S. manages to finance, the U.S. should expect a loss of at least 2.2 jobs on average, above and beyond the jobs that would have been created by investing the money elsewhere in the economy. That translates to between 6.6 and 11 million jobs lost to create the Presidents "3 to 5 million green jobs", in addition to the jobs what would otherwise have been created with the same capital.

And they found that green jobs are costly: each green job created in Spain's effort cost about $750,000, and only one in ten of the new green jobs were permanent. Doing the math on that, creating even 3 million new green jobs would cost $2.25 trillion dollars. Even in a time where the trillion is the new billion, that's a lot of money.

Not only are the jobs pricey, but the goods they produce (wind and solar power plants in this case) jack up energy prices dramatically, and cause additional job losses throughout the economy. Electricity rates in Spain would have to rise by 31% just to pay back the subsidies given to renewable developers.

Finally, the Spanish research team found that "The high cost of electricity due to the green job policy tends to drive the relatively most energy-intensive companies and industries away, seeking areas where costs are lower."

With regard to Denmark and it's vaunted wind power, a report by a Danish think tank observes "Denmark generates the equivalent of about 19% of its electricity demand with wind turbines, but wind power contributes far less than 19% of the Nation's electricity demand. The claim that Denmark derives about 20% of its electricity from wind overstates matters. Being highly intermittent, wind power has recently (2006) met as little as 5% of Denmark's annual electricity consumption with an average over the last five years of 9.7%. In the absence of large-scale electricity storage, any modern electricity system must continuously balance electricity supply and demand, because even small variations in system voltage and frequency can cause damage to modern electronic equipment and other electrical equipment.

Wind power is stochastic,especially in the very short term (e.g., over any given hour, 30 minute, or 15 minute period). This has created a completely new challenge that transmission system operators (TSOs) all over the World are only now learning how to handle. Some draw from Denmark's experience. But Denmark's special circumstances make its experience of limited transferability elsewhere. Denmark manages to keep the electricity systems balanced due to having the benefit of its particular neighbors and their electricity mix. Norway and Sweden provide Denmark, Germany and Netherlands access to significant amounts of fast, short term balancing reserve, via interconnectors. They effectively act as Denmark's "electricity storage batteries". Norwegian and Swedish hydropower can be rapidly turned up and down, and Norway's lakes effectively "store" some portion of Danish wind power.

Over the last eight years West Denmark has exported (couldn't use), on average, 57% of the wind power it generated and East Denmark an average of 45%.The correlation between high wind output and net outflows makes the case that there is a large component of wind energy in the outflow indisputable. The exported wind power, paid for by Danish householders, brings material benefits in the form of cheap electricity and delayed investment in new generation equipment for consumers in Sweden and Norway but nothing for Danish consumers. Taxes and charges on electricity for Danish household consumers make their electricity by far the most expensive in the European Union (EU).

The total probable value of exported subsidies between 2001 and 2008 was DKK 6.8 billion (€916 million) during this period. A similar amount was probably exported prior to 2012 and larger quantities will be exported following the commissioning of 800 MW of new offshore wind capacity in 2013.

The wind power that is exported from Denmark saves neither fossil fuel consumption nor CO2 emissions in Denmark, where it is all paid for. By necessity, wind power exported to Norway and Sweden supplants largely carbon neutral electricity in the Nordic countries. No coal is used nor are there power-related CO2 emissions in Sweden and Norway.

According to the OECD, Denmark has the World's highest tax burden. This applies across a slew of tax sources, including personal income and value added tax. The wind power subsidy arrangements before 2001 were made directly by Government and are not available to the public

Wind energy has replaced some thermal generation in Denmark. It has saved an average emission of about 2.4 million t per year CO2 at a total subsidy cost of 12.3 billion DKK or an average cost of 647 DKK (€ 87 or $124) per ton CO2. Wind power has proven to be an expensive way to save CO2 emissions.

The cost of Denmark's wind capacity to Danish consumers is exacerbated by its inability to use so much surplus electricity. The surplus will increase in 2013 when 800 MW of new offshore capacity is commissioned, increasing Denmark's wind production by 2.7 TWh per year. Nearly all the additional wind power will be exported and this will further depress prices; nearly all the subsidies paid by Danish consumers will also be exported without achieving any significant fossil fuel use nor any CO2 reduction. Achieving own-consumption of all its wind power is technically impossible in the short term and will remain entirely hypothetical until electricity consumption rises and new technical and demand-side solutions have been developed and implemented. In most cases, these have yet even to be invented, let alone proven and costed.

Notwithstanding its many disadvantages wind power's one striking advantage is that, like nuclear, its marginal costs of operation are very small once the capital has been paid. However, unlike nuclear, many ten to fifteen year-old turbines are past their useful life. By contrast, most conventional rotating power plant can enjoy a working life of 40 to 60 years, as evidenced by most power plants in Europe today. This puts into question the strategic, economic and environmental benefits of a power plant that may have to be scrapped, replaced and resubsidized every ten to fifteen years."
(http://www.cepos.dk/fileadmin/user_upload/Arkiv/PDF/Wind_energy_-_the_case_of_Denmark.pdf)

Once again, I thank the Committee for the opportunity to testify, and to submit these answers to the record.

Best,

Kenneth P. Green, D.Env.
Resident Scholar
American Enterprise Institute.

[SUBMITTED BY SENATOR HATCH]

AMERICANS
for TAX REFORM

722 12th Street N.W.
Fourth Floor
Washington, D.C.
20005
T:(202)785-0266
F:(202)785-0261
www.atr.org

Testimony Submitted for the Full U.S. Senate Committee on Finance hearing entitled,
"Climate Change Legislation: Considerations for Future Jobs"

Tuesday, November 10, 2009

My name is Grover G. Norquist, and I am the founder and President of Americans for Tax Reform. ATR was founded in 1985 at the request of President Ronald Reagan and serves as a non-partisan organization that opposes any and all tax increases.

I would like to thank Senator Orrin Hatch (R-UT) and his office for introducing this testimony in the Congressional record for this hearing. The Cap and Trade legislation this Committee is considering is being sold as an attempt to control the climate; however there is no conclusive proof that it will have any effect. There is, however, considerable evidence that this legislation will have a disastrous economic effect on the country. This proposal, S. 1733, the "Clean Energy Jobs and American Power Act," will negatively impact the economy, hurt families, and kill jobs. It will also make the United States less competitive in the global marketplace while allowing other countries to take the lead with an unrestrained economy.

A recent Freedom of Information Act (FOIA) request, issued by the Competitive Enterprise Institute (CEI), to the U.S. Treasury Department revealed that the government's internal reports estimate a cap and trade program will cost between $100 to $200 billion dollars in new taxes per year. This is the equivalent of a hike in personal income taxes by about 15% and the average American household would pay an additional $1,761 a year.[1] Another study by The Institute for Energy Research (IER) found that Waxman-Markey will increase taxes on electricity from coal and natural gas-fired power plants by $1 billion.[2]

Americans will also feel increased pain at the pump as a result of this legislation. A study by Senators Kay Bailey Hutchinson (R-TX) and Kit Bond (R-MO) found that the Waxman-Markey bill will result in a $3.6 trillion gas tax. That breaks down to an additional $2.0 trillion tax on gasoline, a $1.3 trillion tax on diesel fuel, and a $330 billion tax on jet fuel.[3]

These massive new taxes on energy producers and every American family will be far more destructive to those in the lower and middle class. On September 12, 2008, then candidate-Obama said, "I can make a firm pledge. Under my plan, no family making less than $250,000 a year will see any form of tax increase. Not your income tax, not your payroll tax, not your capital gains taxes, not any of your taxes." However, candidate Obama also said, "Under my plan of a cap-and-trade system, electricity rates would necessarily skyrocket."[4] The President's own Treasury Department noted that the increase in rates would be the equivalent of a 15% personal income tax increase by raising an estimated $100 to $200 billion per year.

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[1] McCullagh, Declan, "Obama Admin: Can and Trade Could Cost Families $1,761 A Year." *CBS News*. September 15, 2009. http://www.cbsnews.com/blogs/2009/09/15/taking_liberties/entry5314040.shtml.

[2] "The Other Half of Waxman-Markey: An Examination of the Non-cap-and-trade provisions." The Institute for Energy Research. October 12, 2009. http://www.instituteforenergyresearch.org/2009/10/12/the-other-half-of-waxman-markey-an-examination-of-the-non-cap-and-trade-provisions/.

[3] Hutchinson, Kay Bailey and Bond, Kit, "Climate Change Legislation: A $3.6 Trillion Gas Tax." 2009 http://hutchison.senate.gov/resources/HutchisonBondGasTaxReport.pdf.

Candidate Obama was right. Prices will skyrocket, and it will be those that make less than the $250,000 that will be harmed the most.

As the Hutchinson-Bond report explained, the average household spends five percent of its annual budget on fuel costs. For most lower and middle class working families, gasoline is necessary to get to work and make a living. These families also tend to have longer commutes than the rich and will be hit harder by increased fuel costs.[5]

The Institute for Energy Research has found that the Waxman-Markey bill will result in a $14 billion redistribution of resources from the poor to the rich. This is primarily because shareholders and those involved in trading allowances will be in a position to make money, while those with lower incomes will be paying for the increased taxes and costs.[6]

Additionally, I urge you to oppose punitive taxes on the energy sector over other sectors of the economy. These taxes could come in many forms. A repeal of Section 199 of the Internal Revenue Code, but only for energy companies, will segregate one sector of the economy from getting a domestic manufacturers tax deduction available too all other manufacturers. Removing this tax deduction will pass a $13.3 billion tax onto every American family. According to Paul Schlather, a senior tax partner with PricewaterhouseCoopers, "Every small business in the manufacturing industry should be looking at this as a tax deduction. While Section 199 comes with a very complex set of rules, chances are small businesses will qualify for the deduction much easier than the rules depict."

Second, there have been discussions and proposals to increase the amortization period of the cost of geological expenses incurred in connection with oil and gas exploration within the U.S. According to IRS Publication 535, "Business Expenses", the current law states: You can amortize the cost of geological and geophysical expenses paid or incurred in connection with oil and gas exploration or development within the U.S. These costs can be amortized ratably over a 24-month period beginning on the mid-point of the tax year in which the expenses were paid or incurred. For major integrated oil companies (as defined in section 167(h)(5)) these costs must be amortized ratably over a 5-year period for costs paid or incurred after May 17, 2006 (a 7-year period for costs paid or incurred after December 19, 2007).

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[4] Borelli, Deneen, "Rising energy costs triggered by cap-and-trade will harm low-income workers in inner cities." *The Baltimore Sun.* October 22, 2009. http://www.baltimoresun.com/health/sns-200910220803mctnewsservbc-capandtrade-minoriti,0,7394488.story.

[5] Hutchinson, Kay Bailey and Bond, Kit, "Democrats' hidden gas tax: Extra $1 per gallon at the pump will mean all pain, no gain." *The Washington Times.* October 21, 2009. http://www.washingtontimes.com/news/2009/oct/21/democrats-hidden-gas-tax/?feat=home_commentary

[6] "Blockbuster Study: Working-Class Bears Burden of Cap-and-Trade." The Institute for Energy Research. September 29, 2009. http://www.instituteforenergyresearch.org/2009/09/29/blockbuster-study-working-class-bears-burden-of-cap-and-trade/.

Increasing the amortization period to seven years for only energy producing companies, is the equivalent of a $1.1 billion income tax increase once phased in.

Raising taxes on oil companies by increasing the amortization period of geological and geophysical (G&G) expenditures makes U.S. oil and natural gas exploration projects less competitive globally, thereby discouraging new U.S. production and increasing the nation's reliance on imported oil. Almost all large oil and gas companies are publicly-traded entities, whose shares are owned by millions of investors through their 401(k) plans, retirement plans and pension funds. Taxing away the earnings of those companies negatively impacts the ability of hard-working Americans to achieve a more financially secure future.

Increased energy costs and regulatory burdens are going to destroy jobs in America, sending them overseas to countries like China and India. The Black Chamber of Commerce estimated cap and trade would kill over 2.7 million jobs every year through 2030. The Heritage Foundation estimated 1.1 million jobs lost from 2012- 2030 and 2.5 million each year after that. Even the liberal Brookings Institution estimated 1.7 million jobs would be lost per year.[7]

We are told that these job loses will be offset with new "Green Jobs." The Institute for Energy Research has released a study about the "Green Jobs" program in Germany, and found that not only are these jobs costly, they are also unsustainable. Government subsidies for the solar industry have had a net cost from 2000-2010 of $73 billion (US$) and wind subsidies have cost $28 billion (US$). When compared to the US economy, which is five times the size of Germany's, we can see that it would cost us approximately half a trillion dollars. The entire wind and solar industry is dependent on government handouts including the "Green Jobs" we are told are created from this scheme. The government must pay an estimated $240,000 (US$) for every solar employee. As soon as the government handouts go away for these jobs, so do the jobs. Not only do these new jobs create a new class of people dependent on government welfare, they also kill productive jobs.[8] A Heritage Foundation study has estimated that net job losses, jobs that will be destroyed even if we take the government-dependent "Green Jobs" into consideration, will be 1.145 million.[9]

Increased burdens on lower class families will also come in the form of new regulations on home sales. The Waxman-Markey bill contains 397 new regulations, one of which requires almost all homes to undergo environmental inspections prior to sale. These inspections will increase home prices, as additional inspections and repairs increase base prices. This cost increase is passed on to the buyers making home ownership more difficult. This will also eliminate the "fixer-upper" type homes upon which many low income buyers depend. Many low income families buy less-than-perfect homes because they are cheaper and they can perform needed repairs and improvements themselves. If the home has to pass an inspection prior to sale, the seller will have to make all of the necessary improvements before selling the home. The cap and trade proposal considered today will make home ownership nearly impossible for millions of Americans.[10]

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[7] Borelli, Deneen, "Rising energy costs triggered by cap-and-trade will harm low-income workers in inner cities." *The Baltimore Sun.* October 22, 2009. http://www.baltimoresun.com/health/sns-200910220803mctnewsservbc-capandtrade-minoriti,0,7394488.story.

[8] "Strike Three: First Spain, Then Denmark, and Now Germany…" Institute for Energy Research. October 19, 2009. http://www.instituteforenergyresearch.org/germany/Germany_Study_-_Fact_Sheet_(Final_Version).pdf.

[9] Lieberman, Ben. "Green Job Subsidies Will Destroy Far More Jobs Than They Create." The Heritage Foundation. October 2, 2009. http://www.heritage.org/press/commentary/ed100209c.cfm.

Beyond the direct economic impact of this energy tax, it will also dramatically change the American way of life. Increased travel and commuting costs coupled with an increase in cost to heat and cool homes and keep the lights on means many families will have to make a major shift in priorities. They will also have limited discretionary income for consumer purchases. Families will be forced to live in smaller houses and drive smaller cars. Communities will be constricted because of increased commuting costs, and people will have fewer employment opportunities.[11]

With a void in U.S. based jobs, and the global economy continuing their demand, these manufacturing jobs will go to countries such as China who not putting economic-shackles disguised as climate change legislation on their economies. While the U.S. is imposing higher taxes and energy costs on its citizens and businesses, China is increasing its production and carbon emissions. The result will be the US committing economic suicide while having no proven effect on the climate.

As the United States considers economic destruction and China continues to prosper, what will we gain for all of our sacrifice – increased job loss, higher energy costs and an increased burden on already strained American families? Climatologists estimate that the cap and trade energy tax this Committee will soon consider will at best lower the world-wide temperature by hundredths of a degree by 2050 and no more than two-tenths of a degree by the end of the century.[12]

On top of not reducing the temperature, it also won't reduce our usage or dependency on fossil fuels. In 2015, the US is expected to consume 127 billion gallons of gasoline. As a result of cap and trade, by 2050 we would consume 100 billion gallons of gasoline. In 2015, however, we will use 78 billion gallons of diesel fuel and 31 billion gallons of jet fuel. In 2050, we will use 118 billion gallons of diesel and 48 billion gallons of jet fuel. While gasoline consumption is expected to slightly decrease, diesel consumption will increase by 30 billion gallons, and jet fuel consumption would increase by 17 billion gallons.[13] A recent Environmental Protection Agency (EPA) analysis of the Senate Kerry-Boxer draft concluded that "average household consumption [of energy] would be reduced by less that 1% in all years."[14]

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[10] Young, Ryan, "Cap-and-Trade Will Depress Home Prices." Competitive Enterprise Institute. September 23, 2009. http://cei.org/articles/2009/09/23/cap-and-trade-will-depress-home-prices.

[11] Franc, Michael, "Cap and Trade vs. the American Dream: The House's bill is an economic disaster that keeps getting worse." The Heritage Foundation. May 22, 2009. http://www.heritage.org/Press/Commentary/ed052209b.cfm.

[12] Franc, Michael, "Cap and Trade vs. the American Dream: The House's bill is an economic disaster that keeps getting worse." The Heritage Foundation. May 22, 2009. http://www.heritage.org/Press/Commentary/ed052209b.cfm.

[13] Hutchinson, Kay Bailey and Bond, Kit, "Democrats' hidden gas tax: Extra $1 per gallon at the pump will mean all pain, no gain." *The Washington Times*. October 21, 2009. http://www.washingtontimes.com/news/2009/oct/21/democrats-hidden-gas-tax/?feat=home_commentary

This bill is not about creating jobs; in fact it will destroy jobs and cripple the economy. This bill is not about helping the planet or reducing dependency on foreign oil. This bill is not about national security. As *New York Times* reporter John M. Broder wrote, "Cap and trade… is almost perfectly designed for the buying and selling of political support through the granting of valuable emissions permits to favor specific industries and even specific Congressional districts."[15] This bill is about increased political power, plain and simple. It will raise taxes and energy costs on every American family and force more jobs to our economic competitors.

We believe in an "all of the above" energy approach that incorporates a diverse blend of energy sources without raising taxes and/or increasing the regulatory burden on businesses and without growing the size and scope of the federal government. Thank you.

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[14] "Boxer Releases Chairman's Mark of Clean Energy Jobs and American Power Act." U.S. Senate Committee on Environment and Public Works. October 23, 2009.
http://epw.senate.gov/public/index.cfm?FuseAction=Majority.PressReleases&ContentRecord_id=84691b8e-802a-23ad-4728-e60de8d50fea.

[15] Broder, John M. "From a Theory to a Consensus on Emissions." *The New York Times.* May 16, 2009.
http://www.nytimes.com/2009/05/17/us/politics/17cap.html.

[SUBMITTED BY SENATOR KERRY]

The Washington Post

Falling Behind On Green Tech

By John Doerr and Jeff Immelt
Monday, August 3, 2009

America confronts three interrelated crises: an economic crisis, a climate crisis and an energy security crisis. We believe there's a fourth: a competitiveness crisis. This crisis is particularly evident in America's worldwide standing in the next great global industry, green technology.

There is no topic of greater importance to America's economic future. The question is whether the United States will lead or lag in tomorrow's global energy markets. And the difference between these two futures is dramatic.

Energy in the United States costs more than $1 trillion a year -- for oil, coal, natural gas, nuclear and renewables. This is on top of a similar sum spent on the things that use this energy -- our homes, shops, factories and cars. That means about $2 trillion a year is at stake right here.

Do we want to win the race to lead the next great global industry, clean energy? That is the choice before us.

We are clearly not in the lead today. That position is held by China, which understands the importance of controlling its energy future. China's commitment to developing clean energy technologies and markets is breathtaking.

Consider: Chinese cars are more than one-third more fuel-efficient than U.S. cars. China is investing 10 times as much on clean power, as a percentage of gross domestic product, as the United States is. China is on track to create 150,000 jobs through the deployment of 120 gigawatts of wind power by 2020 -- an amount equivalent to today's global total and nearly five times America's. As a result, China is already curbing its carbon emissions substantially. This year alone, it will abate almost 350 million tons of CO2, as compared with business as usual. That's as much as is emitted by Argentina.

What do Amazon, eBay, Google, Microsoft and Yahoo have in common? Two things: They are the world's five leading Internet technology companies, and they are all American. But when it comes to wind power, the most mature of the clean-energy sectors, of the top five manufacturers (Vestas, GE, Gamesa, Enercon and Suzlon) only one is American. Similarly, the United States is home to only one of the 10 largest solar panel producers in the world and two of the top 10 advanced battery manufacturers. How can we catch up? Not through protectionism or massive government intervention but through the power of good old home-grown innovation.

We are American businessmen. Our job is building businesses and commercializing innovation. Every year, GE invests 6 percent of its industrial revenue in research and development to produce more efficient and cleaner wind turbines, jet engines, locomotives, power turbines and appliances. Kleiner Perkins has invested $680 million in 48 of the most compelling new clean-energy technologies, with $1.1 billion more to invest. We are trying to do our part. But our government's energy and climate policies are our principal obstacle to success.

Right now, the United States has no long-term market signal to tell companies and consumers that it values low-carbon energy. It has no policies to discourage sending hundreds of billions of dollars a year overseas for energy. It does not offer adequate sustained R&D funding to be a serious competitor in this huge business.

Today's policies stifle American innovation and competitiveness. But good policy can flip this dynamic. Five basic changes are needed:

-- Send a long-term signal that low-carbon energy is valuable. We must put a price on carbon and a cap on carbon emissions. No long-term signal means no serious innovation at scale, which means fewer American success stories.

-- Get the rules of the road right for utilities. We must make our utilities a driving force for repowering America, driving efficiency through incentives, a renewable electricity standard and a national unified smart grid.

-- Set energy standards that grow steadily stronger. America should strive to have the most efficient buildings, cars and appliances in the world. The savings will land in the pockets of U.S. consumers and businesses.

-- Get serious about funding research, development and deployment, at scale. The federal government currently spends only $2.5 billion on clean-energy R&D a year -- 0.25 percent of our annual energy bill. Sen. Jeff Bingaman's Clean Energy Deployment Administration is a good idea that would be fast and flexible. But more such programs are needed.

-- Fulfill President Obama's commitment to "become the world's leading exporter of renewable energy." We need a robust trade policy that seeks to open markets abroad -- including the Chinese market -- for U.S. clean-energy products through new trade agreements. Such policies unleash American competitiveness disciplined by market forces. This is widely endorsed by U.S. companies that compete internationally and by the broad-based President's Economic Recovery Advisory Board.

We should carefully design policy to bring in other nations. Think of the Copenhagen climate summit in December as an opportunity to create world markets and momentum for a low-carbon future, just as the Internet set the world on course for an information-rich future. Some say we shouldn't move until China moves. In fact, China is moving full speed ahead -- with or without us.

There is still time for us to lead this global race, although that window is closing. We need low-carbon policies to exploit America's strengths -- innovation and entrepreneurs. We know that building such policies is a heavy political lift. But, without doubt, bad energy policy has cost our country dearly, and the costs of continuing it are incalculable.

John Doerr is a partner in the venture capital firm Kleiner Perkins Caufield & Byers. Jeff Immelt is chairman and chief executive of General Electric.

Climate Change Legislation and U.S. Job Growth:
A Review of the Evidence

By

Margo Thorning, Ph.D.
Senior Vice President and Chief Economist
American Council for Capital Formation*

Before the
Committee on Finance
United States Senate
November 10, 2009

Introduction

Mr. Chairman and members of the Committee on Finance, my name is Margo Thorning, senior vice president and chief economist, American Council for Capital Formation (ACCF),* Washington, D.C. I am pleased to present this testimony to the Committee.

The American Council for Capital Formation represents a broad cross-section of the American business community, including the manufacturing and financial sectors, Fortune 500 companies and smaller firms, investors, and associations from all sectors of the economy. Our distinguished board of directors includes cabinet members of prior Democratic and Republican administrations, former members of Congress, prominent business leaders, and public finance and environmental policy experts. The ACCF is celebrating over 30 years of leadership in advocating tax, regulatory, environmental, and trade policies to increase U.S. economic growth and environmental quality.

Chairman Baucus, Ranking Member Grassley and the members of the Committee on Finance are to be commended for their focus on how policies to reduce U.S. greenhouse gas emissions so as to mitigate the threat of human-induced climate change may affect U.S. economic recovery and job growth. Given the extremely weak state of the U.S. economic recovery and an unemployment rate of 10.2 percent last month, a cautious approach to reducing U.S. Greenhouse gas emissions are clearly warranted. The questions we need to ask are first, what are the likely impacts of bills such as the "American Clean Energy and Security Act" (H.R. 2454) or the

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* *The mission of the American Council for Capital Formation is to promote economic growth through sound tax, environmental, and trade policies. For more information about the Council or for copies of this testimony, please contact the ACCF, 1750 K Street, N.W., Suite 400, Washington, D.C. 20006-2302; telephone: 202.293.5811; fax: 202.785.8165; e-mail: info@accf.org; website: www.accf.org*

"The Clean Energy Jobs and American Power Act" (S.1733) on U.S economy, job growth and competitiveness and second, what are cost-effective strategies to slow both U.S. and global GHG growth? My testimony will address these key issues.

Climate Change Policy and Economic Models: What Should We Look For

The debate about the economic and job impacts of the current climate change bills before Congress has focused on the results of economic modeling from various government agencies, think-tanks and academia. As policymakers study options for reducing GHGs, they need to understand the individual strengths and weakness of the different models used. . In addition, they need to evaluate the reasonableness of the assumptions used in the models on the availability of new technologies, offsets, banking and other parameters of the modeling process. The impacts of most interest are on GDP, employment, labor productivity, investment and savings. Policymakers also are interested in what leverage they may have on these impacts, for example how to implement climate policy in ways that minimize economic costs. Most of the recent studies of the impact of the Waxman Markey bill rely on one of two types of models: macroeconomic models and input-output models.

Strengths and Weakness of Economic Models

- **Macroeconomic models**

According to a report by Dr. Michael Canes of LMI, macroeconomic models have significant advantages over other types of models for understanding the near-term impacts of policies to limit GHG emissions. (http://www.iccfglobal.org/pdf/EconomicModeling2002.pdf). He notes that macro- economic models are dynamic and capture interactive effects between the energy and other sectors of the economy. They also capture international trade effects by accounting for an economy's relationship with other economies. Macroeconomic models do not assume instantaneous full market adjustment but rather allow an economy to suffer involuntarily unemployed resources for a period as market participants adjust to a policy shock. In this way they capture near and intermediate-term adjustment costs as well as longer-term adjustment costs. Dr. Canes concludes that macroeconomic models are the most appropriate models to use when analyzing the impacts of a change in energy prices.

For example, the Global Insight model used by organizations such as the U.S. Department of Energy: Energy Information Administration is an example of a macroeconomic model... The Global Insight model starts by assuming an economy is on a long-run growth path, but then allows policy initiatives (i.e. a cap and trade system) to shock it in such a way that it deviates from the path while adjustment takes place. In other words, resources become involuntarily unemployed while they seek their new most valuable uses, and the economy produces below its potential. The length of adjustment depends on the magnitude of the shock and the flexibility of a country's internal markets, and can take quite a few years to fully work itself out. The Global Insight model contains a financial sector as well a real sector and therefore allows for changes in monetary or fiscal policy, which can mitigate or exacerbate energy policy initiatives through changes in interest rates and their economy-wide effects on savings and investment.

- **Input -Output Models**

An input-Output (I/O) model depicts inter-industry relations of an economy, that is, it shows how the output of one industry is an input to each other industry. An I/O model uses a matrix representation of a nation's (or a region's) economy to predict the effect of changes in one industry on others and by consumers, government, and foreign suppliers on the economy.

While most uses of the input-output analysis focuses on the matrix set of inter-industry exchanges, the actual focus of the analysis from the perspective of most national statistical agencies use input-output tables to assist in benchmarking of gross national product .Input/output tables therefore are an instrumental part of national accounting systems, including that of the U.S.

While useful for national accounting purposes or for studying relationships between industrial sectors, I/O models are static and cannot capture the effects of rising energy prices on U.S. industries' investment, employment decisions or international competitiveness. Because of this weakness, most government agencies, think tanks and academics rely on macroeconomic models when estimating the impact of a policy shift such as a cap and trade system to reduce GHG emissions.

Role of Assumptions in interpreting Economic Model Results

Since the assumptions employed in a macroeconomic model largely determine the effects that a simulation of a policy changes such as a cap and trade system for GHGs) will have on the economy and on job growth, policymakers need to examine them carefully. In modeling climate policy changes, the key assumptions are the projections for economic growth under the baseline forecast as well as factors like how quickly new technology can be deployed for nuclear electric generating capacity, for carbon capture and store for coal and natural gas electric generation ,and for alternative energy sources such as biomass, wind and solar power. Other key assumptions involve the cost of new construction for electric generating capacity and the amount of offsets and banking allowed.

Recent Analyses of the Impact of Climate Change Bills on U.S. GDP and Job Growth

- **Macroeconomic Analysis Results**

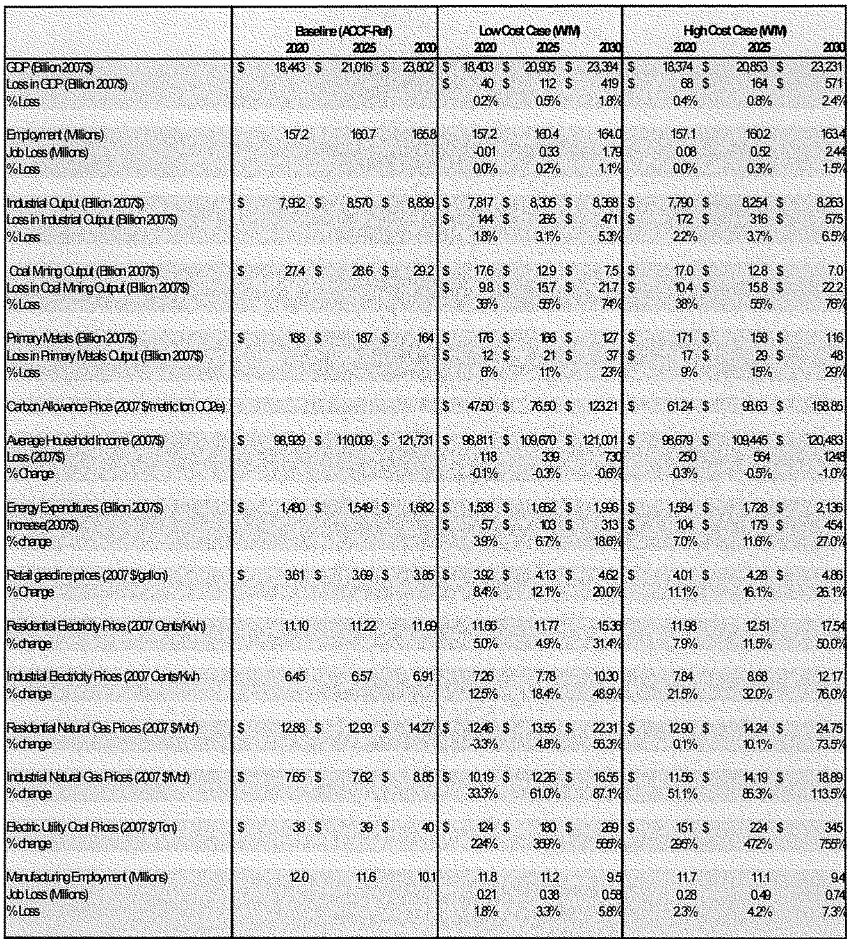
Recent private and government macroeconomic analyses of the impact of cap and trade proposals such as the Waxman-Markey bill (H.R. 2454), which requires reductions in covered GHGs to 17 percent below 2005 levels by 2020, 42 percent by 2030 and to 83 percent below by 2050, show that there are likely to be significant adverse consequences for the U.S. economy and job growth.. For example, an analysis by the American Council for Capital Formation and the National Association of Manufacturers of H.R. 2454 using a version of DOE: EIA's National Energy Modeling System showed that by 2020 the cost of an emission allowance that industry would need to purchase that year for each ton of CO2 emitted would range from $47 to $61 dollars and $123 to $158 in 2030(see **Table 1**). The assumptions used in the low and high cost cases in the ACCF/NAM analysis are in Appendix A.

The results of the ACCF/NAM analysis as well as those of other modeling efforts from CRA/NBCC, EIA and CBO show allowance prices rising to significant levels by 2030, especially when the availability of carbon capture and storage and new nuclear generation capacity are constrained to realistic levels(see **Table 2**). (See full study at http://www.accf.org/media/dynamic/3/media_387.pdf) Other macroeconomic studies from CBO, DOE's EIA and the National Black Chamber of Commerce(NBCC) a (see **Table 2)** show emission allowance prices ranging from $23 to $93 in 2020 and $49 to $190 by 2030.

Higher energy prices slow economic growth and industrial production. The ACCF/NAM study shows that GDP declines by as much as 0.2 to 0.4 percent in 2020 and by up to 2.4 percent relative to the baseline forecast in 2030**(see Table 1**). GDP losses in the other studies reported in **Table 2** show losses of up to 0.8 percent in 2020 and as much as 2.3 percent in 2030.

Substituting more expensive renewable energy for cheaper fossil energy through H.R. 2454's cap and trade provisions, national renewable portfolio standards for electricity generation, and mandating increases in energy efficiency across all sectors of the economy slows productivity growth and has a negative effect on overall U.S. employment. The ACCF/NAM analysis shows that the drag of higher energy prices caused by H.R. 2454 reduces total U.S. employment (net of new jobs created in green industries) by 80,000 jobs in the high cost case in 2020 and by between 1,790,000 to 2,440,000 under the low and high cost cases in 2030 compared to the baseline forecast. Manufacturing is hard hit; it absorbs between 59 to 66 percent of the job losses over the 2012-2030 period in the ACCF/NAM analysis (see **Table 1**). In other analyses cited in **Table 2**, job losses range from 81,480 to 1,800,000 in 2020 and up to 2,317,000 by 2030. By 2030, economic and job impacts are large, due to the tightening of emission reduction targets, increased demand and U.S. population growth according to the results of various macroeconomic analyses cited in Table 2.

Table 1. Summary of the ACCF/NAM Macroeconomic Analysis of the Waxman/Markey bill (H.R. 2454) for the United States



	Baseline (ACCF-Ref)			Low Cost Case (W/M)			High Cost Case (W/M)		
	2020	2025	2030	2020	2025	2030	2020	2025	2030
GDP (Billion 2007$)	$ 18,443	$ 21,016	$ 23,802	$ 18,403	$ 20,905	$ 23,384	$ 18,374	$ 20,853	$ 23,231
Loss in GDP (Billion 2007$)				$ 40	$ 112	$ 419	$ 68	$ 164	$ 571
% Loss				0.2%	0.5%	1.8%	0.4%	0.8%	2.4%
Employment (Millions)	157.2	160.7	165.8	157.2	160.4	164.0	157.1	160.2	163.4
Job Loss (Millions)				-0.01	0.33	1.79	0.08	0.52	2.44
% Loss				0.0%	0.2%	1.1%	0.0%	0.3%	1.5%
Industrial Output (Billion 2007$)	$ 7,952	$ 8,570	$ 8,839	$ 7,817	$ 8,305	$ 8,368	$ 7,790	$ 8,254	$ 8,263
Loss in Industrial Output (Billion 2007$)				$ 144	$ 265	$ 471	$ 172	$ 316	$ 575
% Loss				1.8%	3.1%	5.3%	2.2%	3.7%	6.5%
Coal Mining Output (Billion 2007$)	$ 27.4	$ 28.6	$ 29.2	$ 17.6	$ 12.9	$ 7.5	$ 17.0	$ 12.8	$ 7.0
Loss in Coal Mining Output (Billion 2007$)				$ 9.8	$ 15.7	$ 21.7	$ 10.4	$ 15.8	$ 22.2
% Loss				36%	55%	74%	38%	55%	76%
Primary Metals (Billion 2007$)	$ 188	$ 187	$ 164	$ 176	$ 166	$ 127	$ 171	$ 158	$ 116
Loss in Primary Metals Output (Billion 2007$)				$ 12	$ 21	$ 37	$ 17	$ 29	$ 48
% Loss				6%	11%	23%	9%	15%	29%
Carbon Allowance Price (2007 $/metric ton CO2e)				$ 47.50	$ 76.50	$ 123.21	$ 61.24	$ 98.63	$ 158.85
Average Household Income (2007$)	$ 98,929	$ 110,009	$ 121,731	$ 98,811	$ 109,670	$ 121,001	$ 98,679	$ 109,445	$ 120,483
Loss (2007$)				118	339	730	250	564	1248
% Change				-0.1%	-0.3%	-0.6%	-0.3%	-0.5%	-1.0%
Energy Expenditures (Billion 2007$)	$ 1,480	$ 1,549	$ 1,682	$ 1,538	$ 1,652	$ 1,996	$ 1,584	$ 1,728	$ 2,136
Increase(2007$)				$ 57	$ 103	$ 313	$ 104	$ 179	$ 454
% change				3.9%	6.7%	18.6%	7.0%	11.6%	27.0%
Retail gasoline prices (2007 $/gallon)	$ 3.61	$ 3.69	$ 3.85	$ 3.92	$ 4.13	$ 4.62	$ 4.01	$ 4.28	$ 4.86
% Change				8.4%	12.1%	20.0%	11.1%	16.1%	26.1%
Residential Electricity Price (2007 Cents/Kwh)	11.10	11.22	11.69	11.66	11.77	15.36	11.98	12.51	17.54
% change				5.0%	4.9%	31.4%	7.9%	11.5%	50.0%
Industrial Electricity Prices (2007 Cents/Kwh	6.45	6.57	6.91	7.26	7.78	10.30	7.84	8.68	12.17
% change				12.5%	18.4%	48.9%	21.5%	32.0%	76.0%
Residential Natural Gas Prices (2007 $/Mcf)	$ 12.88	$ 12.93	$ 14.27	$ 12.46	$ 13.55	$ 22.31	$ 12.90	$ 14.24	$ 24.75
% change				-3.3%	4.8%	56.3%	0.1%	10.1%	73.5%
Industrial Natural Gas Prices (2007 $/Mcf)	$ 7.65	$ 7.62	$ 8.85	$ 10.19	$ 12.26	$ 16.55	$ 11.56	$ 14.19	$ 18.89
% change				33.3%	61.0%	87.1%	51.1%	85.3%	113.5%
Electric Utility Coal Prices (2007 $/Ton)	$ 38	$ 39	$ 40	$ 124	$ 180	$ 269	$ 151	$ 224	$ 345
% change				224%	359%	565%	295%	472%	755%
Manufacturing Employment (Millions)	12.0	11.6	10.1	11.8	11.2	9.5	11.7	11.1	9.4
Job Loss (Millions)				0.21	0.38	0.58	0.28	0.49	0.74
% Loss				1.8%	3.3%	5.8%	2.3%	4.2%	7.3%

- **Input/Output Model Results**

Two recent analyses using static input/output models state that bills such as Waxman/ Markey would have a net positive impact on U.S. employment (see **Table 3**). For example, the Center for American Progress/Political Economy Research Center report claims that there would have been be a net gain of 1,700,000 jobs in 2008 if policies like Waxman Markey had been in place.

Table 2. Economic Impact of the Waxman-Markey Bill: Summary of Key Macroeconomic Modeling Results

	2020		
	Allowance Prices (2007$ per metric ton)	GDP Impact (% Change from BAU)	Impact on Jobs (Change from BAU)
ACCF/NAM-Low Cost[1]	$47.5	-0.2%	10,000
ACCF/NAM-High Cost[1]	$61.24	-0.4%	-80,000
CRA/NBCC[2]	$30	-0.8%	-1,800,000
EIA- NEMS Basic[3]	$31.7	-0.3%	-81,480
EIA- NEMS Limited[3]	$93.3	-0.7%	-355,210
CBO[4]	$23	-0.2 to -0.7%	N/A

	2030		
	Allowance Prices (2007$ per metric ton)	GDP (% Change) (% Change from BAU)	Impact on Jobs (Change from BAU)
ACCF/NAM-Low Cost[1]	$123.21	-1.8%	-1,790,000
ACCF/NAM-High Cost[1]	$158.85	-2.4%	-2,440,000
CRA/NBCC[2]	$49	-1.0%	-2,200,000
EIA- NEMS Basic[3]	$64.8	-0.8%	-597,000
EIA- NEMS Limited[3]	$190.5	-2.3%	-2,317,000
CBO[4]	N/A	-0.4 to -1.1%	N/A

1. "Analysis of The Waxman-Markey Bill "The American Clean Energy and Security Act of 2009" (H.R. 2454) Using The National Energy Modeling System" (NEMS/ACCF-NAM 2) A Report by the American Council for Capital Formation and the National Association of Manufacturers, August 2009.
2. " Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R.2454)" National Black Chamber of Commerce, August 2009.
3. "Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009," by the Energy Information Administration, U.S. Department of Energy, August 2009.
4. "The Economic Effects of Legislation to Reduce Greenhouse-Gas Emissions", Statement of Douglas W. Elmendorf," CBO, October 2009.

The CAP/PERI report identifies some of the problems with its analysis. The report states, "there are certainly weaknesses with our use of the input-output model. The most important are that it is a static model, a linear model, and a model that does not take into account structural changes in the economy.........Our model also assumes that a given amount of spending will have a proportionate effect on employment no matter how much the level of spending changes, either up or down. For example, the impact of spending $1 billion on an energy efficiency project will be exactly 1,000 times greater than spending only $1 million on the exact same project." Thus, as the CAP/PERI report admits, its analysis is incapable of reflecting real-world changes in prices, human and physical resource constraints, productivity, saving and investment, productivity, etc. That would occur when a cap and trade system is put in place. As a result of the inadequacy of the I/O model approach, the report's finding that net U.S. Jobs would increase under Waxman-Markey can not be taken seriously.

Table 3. Economic Impact of the Waxman-Markey Bill: Summary of Key Input/Output Modeling Results

	Allowance Prices ($ per metric ton)	GDP (% Change) (% Change from BAU)	Impact on Jobs (Change from BAU)
CAP/PERI[1]	N//A.	N//A. Concludes from various studies "the impact of a cap and trade system on U.S. GDP will be negligible"	1,700,000(2008)
ACEEE[2]	$47	0%	424,000(2030)

1. "The Economic Benefits of Investing in Clean Energy," Robert Pollin, James Heintz, and Heidi Garrett-Peltier, Department of Economics and Political Economy Research Institute (PERI), June 2009.
2. "Climate Change Policy as an Economic Redevelopment Opportunity: The Role of Productive Investments in Mitigating Greenhouse Gas Emissions," John A. Laitner, American Council for an Energy-Efficient Economy, October 2009.

Similarly, a new report by the American Council for an Energy-Efficient Economy, which also uses a static I/O model, states that overall employment would increase by 424,000 jobs in 2030. The ACEEE analysis is plagued by the same weaknesses as the CAP/PERI report.

Energy Prices and U.S. Job Growth and Competitiveness

The results of the macroeconomic analyses cited in Table 1 above suggest that legislation like the Waxman/Markey bill (H.R. 2454) will, by raising U.S energy prices, make it harder to keep the U.S. economic recovery going and to reduce the unemployment rate. Each one percent increase in U.S. GDP growth is accompanied by a 0.2 percent increase in energy use: therefore, the higher the price of energy, the slower the rate of economic recovery.

A real world example of the effect that increased energy prices have on U.S. industry and employment can be observed by examining trends in the U.S. chemical industry. For example, chlorine is an essential chemical building block used in the production of pharmaceuticals, medical devices, safety equipment, computers, automobiles, aircraft parts and crop protection chemicals. Chlorine production in based on electro-chemistry and is one of the most energy-intensive production processes. In recent years, U.S. chlorine capacity has been shut down because of record high electricity costs arising from high natural gas prices, according to the American Chemistry Council. In addition, a report by SRI Consulting indicates that ammonia capacity fell from 14.8 million tons in 1999 to 13.6 million tons in 2007, an 8% reduction. Data on global natural gas prices for the third quarter of 2008 show that U.S. producers faced much higher prices than many other countries. Thus it is not surprising that much chemical production has migrated to lower cost locations.

Similarly, nitrogenous fertilizers play a major role in boosting crop yields and ammonia is the key raw material for these fertilizers. Ammonia production has also been affected by sharply rising natural gas prices. According to The Fertilizer Institute, from 1999-2007, 25 ammonia plants have been closed and a report by SRI Consulting indicates that ammonia capacity fell from 15.5 million metric tons in 1999 to 9.8 million metric tons in 2003, a 37% reduction. Approximately 120,000 jobs have been lost in the U.S. chemical industry since 1999, when natural gas prices began their sharp rise, according to the American Chemistry Council.

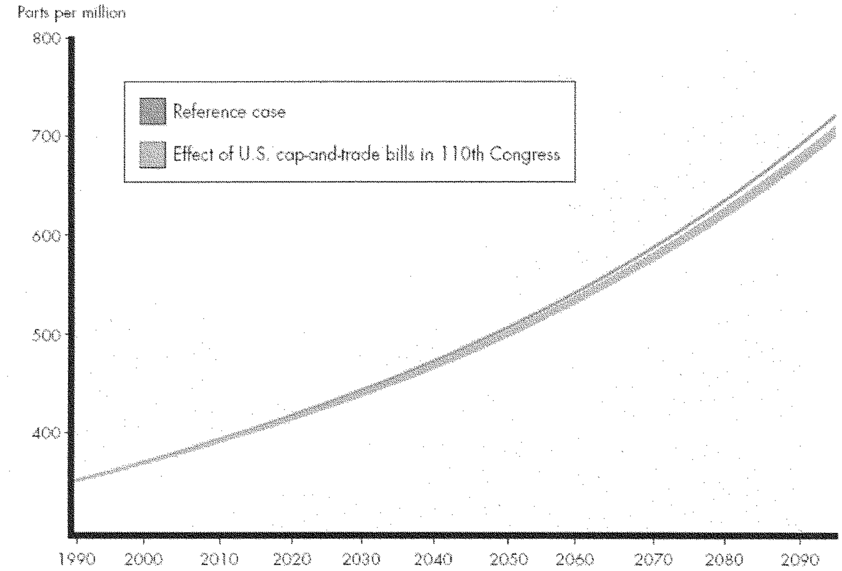
In addition, policymakers should consider proposals to remove restrictions faced by the domestic oil and gas industry regarding access to both onshore and offshore reserves. Promoting U.S. energy supplies could lessen dependence on foreign sources while enhancing U.S. job growth. Further policymakers should avoid increasing taxes on the oil and gas industry to avoid raising the cost of capital for needed new investment. Improving the tax treatment for U.S. energy investments would also help pull through cleaner, less emitting technologies in the U.S. An analysis prepared by Ernst&Young for the ACCF showed that U.S. firms face much higher taxes on new investment than do their competitors in other countries(see study at http://www.accf.org/media/dynamic/8/media_82.pdf)

- **Environmental Impact of Mandatory U.S. GHG Emission Reductions**

As described above, meeting the mandatory reduction targets of proposed legislation such as the Waxman/Markey or the Kerry/Boxer bill (S.1733) are likely to have a significant impact on U.S. economic and job growth due to the sharply higher energy prices needed to bring down emissions. However, the U.S. climate change policies will have virtually no environmental benefits unless developing countries, whose emissions are growing strongly, also participate. As noted in the 2009 Council of Economic Advisers' Report to the President, global concentrations of CO2 in 2100 will be almost unaffected by U.S. emission reductions. (See **Figure 1).**

The difficulties of getting major emitters in the developing world to accept binding emission limits is noted in an analysis by Lee Lane and David Montgomery, *Political Institutions and Greenhouse Gas Controls,* for the AEI Center for Regulatory and Market Studies (December 2008), concludes that institutions limit the extent to which efficient policies to reduce GHGs are likely to be adopted. The authors note that there are no third parties to enforce climate policy agreements and nations differ widely in their interest in restricting GHG emissions. Therefore, high transaction costs will attend efforts to reach and maintain broad GHG controls. So far, these transactions costs have blocked agreement and there seems little reason to expect that these constraints will soon vanish. The most likely course for future climate policy is drift and fragmentation, the authors conclude.

Figure 1. Global CO2 Concentrations:
Carbon emissions are projected to rise over the next several decades



Source: Economic Report of the President, Annual Report of the Council of Economic Advisers, January 2009, Chart 3-6, pg 124.

Thus, without strong international participation to reduce GHGs, the slower U.S. economic and job growth that would result from the emission reduction targets being debated by U.S. policymakers would yield little environmental benefit.

- **Conclusions**

To be effective, policies to reduce global GHG emission growth must include both developed and developing countries. Polices that enhance technology development and transfer are likely to be more widely accepted than those that require sharp, near- term reductions in per capita energy use. Extending the framework of the Asia Pacific Partnership on Clean Development and Climate and other international partnerships will allow developed countries to focus their efforts where they will get the largest return, in terms of emission reductions for the least cost.

Finally, if the United States does adopt a mandatory greenhouse gas emissions reduction program, serious consideration should be given to implementing a carbon tax rather than an EU style cap and trade system. A key component of any mandatory U.S. program should be allowing emissions to increase as both economic growth and U.S. population increase.

Senate Finance Committee
Climate Change Legislation: Considerations for Future Jobs
November 10, 2009
Responses to Questions for Dr. Margo Thorning, Senior Vice President and Chief Economist, American Council for Capital Formation

Questions from Senator Baucus

1. You have stated that climate legislation will result in a loss of up to 2.4 million jobs by 2030. Your conclusion was based on a version of an economic model created by the Energy Information Administration, but I understand the input assumptions are not provided in your study. Would you be willing to release all of the assumptions that went into your analysis?

   Answer:

   The assumptions that went into the ACCF/NAM analysis of the Waxman Markey bill were inadvertently omitted from the testimony submitted to the Committee on November 9th, 2009. A corrected version was sent later on the 9th, it contained the assumptions used in the analysis (see especially pages 13 and 46 in the full report at http://www.accf.org/media/dynamic/3/media_387.pdf

The main assumptions used in the ACCF/NAM study are pasted in below for you're your convenience:

ACCF/ NAM Low and High Cost CASE SPECIFICATIONS

For Waxman Markey Analysis

	High Cost	Low Cost
TECHNOLOGY BUILD CONSTRAINTS (2030 Build Limits)		
NUCLEAR	10 GW	25 GW
IGCC w SEQUESTRATION	15 GW	30 GW
BIOMASS	Max 3 GW/year	Max 5 GW/year
WIND	Max 5 GW/year	Max 10 GW/year
NGCC w SEQUESTRATION	15 GW	30 GW
TECHNOLOGY TOTAL CAPITAL REQUIREMENT (2007 $/kW)		
NUCLEAR	3,318	3,318
IGCC	2,378	2,378
NGCC	948	948
SUPERCRITICAL PC	2,058	2,058
IGCC w SEQ	3,496	3,496
NGCC w SEQ	1,890	1,890
WIND - ONSHORE	1,923	1,923
WIND OFFSHORE	3,851	3,851
BIOMASS	3,766	3,766
OTHER SPECIFICATIONS		
OFFSETS(Annual)	1,000 MMT(95% domestic, 5% international)	1,000 MMT(95% domestic, 5% international)
OIL PRICE PROFILE	AEO2009	AEO2009
NATURAL GAS PRICES	Not Constrained	Not Constrained
CELLULOSIC ETHANOL	With HR6 - Not Constrained	With HR6 - Not Constrained
BANKING	5,000 MMT	5,000 MMT
HR6	YES	YES
ALLOWANCE PRICES (Annual Growth)	Constrained to 10%	Constrained to 10%
STRATEGIC RESERVE	Not modeled	Not modeled

Question from Senator Baucus:

2. Several news recent reports indicate that China is making great strides in the development and manufacture of clean-energy technology. An August 2009 Christian Science Monitor article notes that Chinese factories already make a third of the world's solar cells – six times more than the U.S., and that last year China graduated 17 PhDs in the field of underground coal gasification, while only two others graduated in the rest of the world.

   Please comment China's green technology developments and the impact these will have on green technology and jobs in the United States. Please also share your thoughts on the U.S.'s opportunity to engage in similar technology development and job creation, such as through incentives like the new advanced energy manufacturing credit that Congress passed in February.

   Answer:

   China has become an important supplier for equipment used to generate renewable energy including wind and solar power. In addition, they are trying to develop clean energy technology for batteries so as to be a leader in the all- electric car industry. Having a strong competitor like China will challenge U.S. engineers and manufacturers to come up with even better products. Given China's lower costs of manufacturing it will difficult for the U.S. to compete on price alone.

   One solution which could help offset China's competitive advantage is to expand the Advanced Energy Manufacturing Tax Credit in the ARRA Act of 2009. The 30 percent tax credit is only available for projects completed with 4 years of their tax credit acceptance. Extending the time period for the tax credit and broadening the types of technologies for which investments can qualify for the tax credit could be helpful. The current U.S. tax code treats energy investments relatively poorly, compared to our international competition. For example, a 2007 report by the American Council for Capital Formation, an international comparison of the tax treatment of energy investments prepared by Ernst &Young, shows that the U.S. has the slowest deprecation and highest effective tax rates for a wide range of energy investments (see full report and especially Tables 1 and 7 at http://www.accf.org/media/dynamic/8/media_82.pdf.

Questions from Senator Cantwell

1. In addition to thinking about the costs of policy action on climate change, we need to be just as aware of the potential costs of inaction. There is going to be tremendous energy growth, particularly in the developing world, over the next century. Energy is already a $6 trillion market, and it is growing fast. I want to be sure that the United States is the world's leading supplier of clean energy technologies to meet the exploding world demand.

- How should policymakers create and structure incentives that enable US leadership in clean energy technologies? Is a consistent, stable price on fossil carbon an effective or necessary component?

- How do you think we should balance the protection of existing industries with the promotion of future industries? Isn't there a real risk that if we fail to create the right investment incentives at home, we may miss out on the lucrative opportunities that will accompany global leadership in clean energy?

Answer:

One way to promote U.S. leadership in energy efficiency and clean-energy technology is to reduce the cost of capital for new investment by improving depreciation and reducing the corporate tax rate. For example, a 2007 report by the American Council for Capital Formation, an international comparison of the tax treatment of energy investments prepared by Ernst &Young, shows that the U.S. has the slowest deprecation and highest effective tax rates for a wide range of energy investments (see full report and especially Tables 1 and 7 at http://www.accf.org/media/dynamic/8/media_82.pdf. Reducing the tax burden on U.S. investment would help promote all kinds of technologies including that for energy efficiency and for clean technologies. As global economies recover from the current recession, energy prices demand and prices will rise, thus creating a market for energy efficient investments without the need for a price on carbon provided by government. In addition, 30 states already have renewable energy mandates, these mandates will support additional private sector resources going into clean energy. The desire to reduce U.S. GHGs needs to be tempered with the realization that developing countries will be the leaders in global GHG production in the future; in fact, China's GHG emissions are now larger that those of the U.S. The Copenhagen Accord, reached at the COP 15 meetings shows how very difficult it will be to get developing countries to curb their emission growth. . Given that fact, the U.S. should be very careful about imposing costly additional GHG reduction mandates on U.S. households and business as the cost is likely to exceed the benefit.

Assuming that the U.S. does adopt a cap and trade system for GHG emissions or puts a price carbon, the best policy would be to support the workers whose jobs are lost when U.S. produced goods become less competitive. Subsiding carbon intensive industries through tariffs on imports from countries without curbs on GHGs or direct payments to companies would lead to inefficient production and waste of taxpayer dollars. A better approach is to protect older workers who can not easily be retrained with monthly support such as unemployment compensation until they retire.

2 One of the most important ways we can stimulate economic growth and job creation through climate policy is by creating consistent price signals and long-term incentives for investment in innovation and new energy technologies.

  - In any policy involving the auctioning of emissions allowances, do you think that price controls—both price floors and ceilings—are necessary to manage volatility and uncertainty?

- Would a well-designed, price collar (i.e. explicit upper and lower bounds for the price of allowances) provide sufficient assurances for substantial investment in capital-intensive, low-carbon energy systems such as CCS and nuclear, as well as other, more conventional

Answer:

If the U.S. does adopt additional programs to reduce GHGs, a tax on carbon emissions or a cap and trade system with price floors and price collars would be the best approach. Such policies would reduce the volatility and uncertainty about energy prices for business investment and householder's purchases of durable equipment since they would have a more information about future energy prices.

Questions from Senator Menendez

1. In your testimony, you state "US climate change policy will have virtually no environmental benefits unless developing countries also participate". I completely agree that curbing the greenhouse gas emissions of developing countries is absolutely crucial to combating climate change – and I am convinced that this should be one of our top priorities.

   Realistically however, the United States will not get a climate treaty without first leading the way. We are a global power. Our actions send a powerful message to the rest of the world. For years our message was that we want to ignore climate change and continue to pollute as long as we want. Our new message must be that we are willing to put our money where our mouth is on climate change. Your testimony presents us with a false choice – do nothing because they will do nothing, or do nothing until they do something first.

   How do you propose to get nations with one tenth the per capita income as the United States to seriously tackle climate change without the United States leading the way?

2. Why doesn't your study project the costs of not acting on climate change? Do you plan on updating your study to include these costs or do you not believe in climate change or that it is caused by human actions? Abating climate change will seem quite cheap when food production starts dropping, more powerful storms wreck our coasts, heat waves endanger the health of the elderly, and when millions of climate refugees leave their homelands in search of a habitable place to live.

Answers to:

Question 1:

Reducing global GHGs requires a global approach based on the spread of existing technologies for cleaner energy, energy efficiency and conservation as well as the development of new technologies. Developing countries like China and India have made it clear that economic growth is their top priority. Further, the recent COP 15 meeting shows the extreme difficulty of getting developing countries to place a higher priority on reducing their GHGs because they know that economic growth requires additional energy use. There is little reason to think that if the U.S. adopts binding GHG emission targets such as those in the Waxman Markey bill, that the Chinese or Indian will also agree to significant cuts. Both countries have millions of citizens living in severe poverty, thus maintaining the economic growth required for political stability means that improving access to reasonably priced energy must be a top priority. Similarly, U.S. policymakers must bend every effort to reduce the unacceptably high levels of unemployment and restore economic growth. It is unlikely that the U.S. public will be willing to allow Congress and the Administration to send billions of taxpayer dollars to countries like China and India to pay them to switch from coal fired to natural gas or nuclear or renewable electricity generation. Therefore, programs like the Asia Pacific Partnership on Development and the Major Economies Initiative with their focus on technology transfer and economic development should be continued. Research to develop cleaner energy sources, carbon capture and storage and energy efficiency should also be accelerated in the U.S. as will as globally. As new technology becomes cheaper, developing countries will want to adopt it because it reduces energy costs as well as having positive environmental benefits.

Question 2.

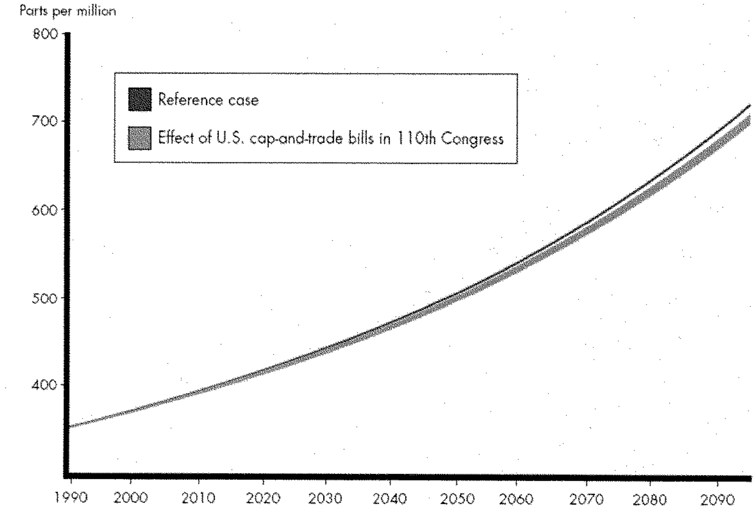
None of the mainstream economic analyses of the Waxman/ Markey bill based on macroeconomic models from the EPA, EIA, private energy modeling firms or academic organizations attempt to model the economic effects of warmer temperatures or change in rainfall and snow patterns on U.S. economic activity. GHG emission from anywhere on the globe impact GHG concentrations globally and thus, presumably, impact temperatures, thus it would be impossible to model the economic impact of temperature and rainfall changes caused by the U.S. adopting legislation like Waxman/ Markey or Kerry Boxer. The EPA report on the Kerry Boxer bill notes that "this analysis doesn't quantify the impacts of higher temperatures and other effects of increasing GHG concentrations" (page 28 of EPA's October 23rd analysis.) The macroeconomic models are designed to quantify the economic effects on countries of changes in how they use and produce energy as a result of a policy shock like the Waxman Markey or Kerry Boxer bill. Since we can not predict whether developing countries will curb their GHG growth it is not possible to isolate the impact on the economy due solely to the actions of the U.S.

Sacrificing current economic growth not only in the U.S. but also in developing countries (if they try to substitute more expensive energy for cheaper fossil fuel energy) means that more people will live in poverty due to slower economic progress. For example, analysis by John Holdren, President Obama's Science Advisor, shows that maternal and childhood poverty is by far the largest contributor to global mortality. Climate change is at the bottom of Holdren's list, in terms of its impact on global mortality.

However, the EPA, in a separate analysis has quantified the impact of the U.S. going it alone in reducing its emissions. Below is a figure from the President's Economic Report for 2009. Figure 1 shows that without strong participation from developing countries, U.S. emission reductions would not make much of an impact on in reducing global GHG concentrations by the end of this century. In its October 23 report on Kerry Boxer, EPA makes the same observation about the fact that unless there are large cuts in emissions by developing countries it will not be possible to keep GHG concentrations below 647 ppm in 2100.

Figure 1. Global CO2 Concentrations:

Carbon emissions are projected to rise over the next several decades



Source: Economic Report of the President, Annual Report of the Council of Economic Advisers, January 2009, Chart 3-6, pg 124.

Questions from Senator Cornyn

1. Do you agree with analyses that suggest that the 2.25% allocation in both the Waxman-Markey and Kerry-Boxer bill adequately protects the domestic refining industry from trade competition and job loss?

2. If you were to develop a strategy to limit the growth in greenhouse gas emissions, what would be the most efficient and environmentally effective policy that protects against negative impacts on the economy?

3. Do you think the EPA's analysis of Kerry-Boxer adequately addresses the effects of additional EPA mandates on various sectors, and further EPA regulation of greenhouse gases not excluded by the bill? Were all of the costs associated with these requirements considered?

Answers to:

Question 1:

The 2.25% allocation for domestic refiners is inadequate to protect the industry from loss of jobs and increased imports of refined products. In a recent paper, " A Misleading Analysis of Allowance Allocations to Refiners" , Dr. David Montgomery of Charles River Associates states that it would take a 6% allocation to cover refiners' allowance purchase costs that will not be recovered through higher prices to consumers(see Appendix A for full paper). He notes that a White Paper being circulated claims that refiners will be able to pass 65% of the costs of allowances required to cover process emissions from refining through to retail customers. U.S. refiners will be subjected to this new penalty, but imported gasoline and other refined products will not. The White Paper bases its claim on the argument that imports of refined products, principally gasoline, will not restrain price increases, and that a simple economic formula implies that the passthrough will be 65%. Dr. Montgomery notes that two reasons are given for the claim that imports will not restrain price increases: 1. product imports have not increased except "temporarily" in response to disruptions like Hurricane Katrina, because of the U.S. "boutique fuels" regulations that cannot be met by imports; and, 2. domestic refiners "dominate" the market and can somehow prevent price increases. They have their facts wrong on both of these, and fail to understand the fundamental supply and demand forces at work in gasoline markets.

Second, the statistic that domestic refiners produce 90% of refined products supplied in the U.S. says nothing about their ability to raise prices. Prices are determined by the marginal source of gasoline – the source where production will expand and contract when prices change. The Federal Trade Commission puts it that "The price of gasoline in [one area] is ultimately constrained by the price of the marginal supply of gasoline from another area]. ... Marginal supply is the swing supply that would enter the market if prices rose and exit the market if prices fell." There is nothing wrong with the formula that the paper uses to calculate the passthrough percentage, but it is incorrect to use demand elasticity when imports are the marginal supply. The paper uses the formula to calculate how much of a cost penalty imposed only on U.S. refiners could be passed on to consumers, when competing imported products have no cost increase. As the FTC has pointed out, "Individual firms may have little or no market power even if industry demand is inelastic. It is a mistake to equate low demand elasticity with the ability of a firm to exercise market power."[1]

Dr. Montgomery concludes that the cost of allowances to cover these emissions would be approximately 8 cents per gallon, according to the same paper, so that ability to pass through only 65% of allowance cost would leave the refiner with an unrecovered cost of about 3 cents per gallon. Since the White Paper claims that the total cost of allowances for process emissions is about 1 cent per gallon, and that the 2.25% allocation would cover that entire cost, the paper's own formula applied to the 3 cent per gallon unrecovered cost leads to the recommendation that refiners should initially be allocated more than 6% of all allowances to cover their unrecovered costs associated with consumer use of fuels.

Question 2:

First, to protect the economy and encourage reduction in U.S. GHG emissions the U.S. tax code should be improved to reduce the cost of capital for new investment (see answer above to Senator Cantwell's questions and ACCF international comparison of the tax treatment of energy investments at http://www.accf.org/media/dynamic/8/media_82.pdf As discussed above, the U.S. should improve depreciation allowances and reduce the corporate tax rate for new energy investments of all types. Non profit organizations such as rural electric coops should be provided with low cost loans or other provisions to reduce their cost of new investment. Second, the U.S. should consider adopting a small carbon tax on fossil fuels ($5.00 per ton, for example) and use the money for research and development of carbon capture and storage, nuclear generation, renewables, energy efficiency, etc.

Question 3:

The Kerry-Boxer bill (S. 1733) does not contain any of the Clean Air Act (CAA) exemptions included in the Waxman Markey bill (H.R. 2454), so that EPA CAA rulemakings would continue in addition to the cap-and-trade program.
EPA's report on the economic impact of the Kerry-Boxer bill is based on its earlier modeling of the H.R. 2454. EPA did not engage in a new analysis of S.1733. EPA's failure to do an analysis of the impact of having both a cap and trade system to reduce GHGs and also having EPA regulate emissions under the CAA means that its cost estimates are likely to be severely understated.

Two other points about EPA's Kerry Boxer analysis bear mentioning. First is the assumption used in most of EPA's scenarios about new nuclear plants for electricity generation? The EPA report says that the new KB report is based on their Waxman Markey analysis which assumes a 150% increase in the number nuclear plants by 2050. It seems likely that that is also the number assumed for the KB report. The U.S. currently has approximately 100 nuclear plants, to increase that number by 150% would mean that we would have to build 150 new plants by 2050, or about 4 per year for the next 4 decades. Since we haven't built a nuclear plant in the last 30 years in the U.S., this assumption seems highly unlikely. See slide 17 for the details of the EPA nuclear assumptions at http://www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis.pdf

The significance of this is of course that when you assume a large number of carbon free sources of electricity will be put in place, the cost of reducing GHG emissions is substantially reduced. Thus the allowance prices and economic impacts shown in Table 4 on page 17 of the new Kerry Boxer report (attached) are likely to be seriously underestimated.

Second, The EPA's Kerry Boxer analysis also assumes that the "institutions are put in place to process the domestic and international offsets need to realize reductions on the magnitude shown in the analysis (see page 20, 1st full paragraph of the EPA report). This assumption, if it came true, would allow U.S. companies to purchase less costly offsets from developing countries which have emission reduction targets in place. In reality, the assumption is not likely to be realized since China and India have made it quite clear they will not undertake programs that would set limits on their emissions. Thus U.S. companies would not be able to tap into that market under the current provisions of the Waxman Markey and Kerry Boxer bills and would likely face much higher prices for emission allowances than shown in the EPA analysis.

Appendix A

A Misleading Analysis of Allowance Allocations to Refiners

W. David Montgomery[2]

Charles River Associates

A white paper is circulating that asserts refiners will be overcompensated by a 2.25% allowance allocation.[3] This conclusion is incorrect, and indeed the assumptions and calculations in the paper support the opposite conclusion, that it would take a 6% allocation to cover refiners' allowance purchase costs that will not be recovered through higher prices to consumers.

The paper claims that refiners will be able to pass 65% of the costs of allowances required to cover process emissions from refining through to retail customers. U.S. refiners will be subjected to this new penalty, but imported gasoline and other refined products will not. The paper bases its claim on the argument that imports of refined products, principally gasoline, will not restrain price increases, and that a simple economic formula implies that the passthrough will be 65%. Two reasons are given for the claim that imports will not restrain price increases: 1. product imports have not increased except "temporarily" in response to disruptions like Hurricane Katrina, because of the U.S. "boutique fuels" regulations that cannot be met by imports and 2. Domestic refiners "dominate" the market and can somehow prevent price increases. They have their facts wrong on both of these, and fail to understand the fundamental supply and demand forces at work in gasoline markets.

First, as the chart below shows, imports of finished gasoline and blendstocks have increased dramatically since the mid-nineties, contradicting the statement in the paper that "The only times imports increase is at times of outages of U.S. refineries (e.g. after Hurricane Katrina) but as soon as U.S. capacity is back up and running, imports diminish again."[4] This statement is simply wrong, and as a factual matter the authors seem to have missed the increase in blendstocks, which are then mixed with oxygenates in the U.S. to meet U.S. requirements.

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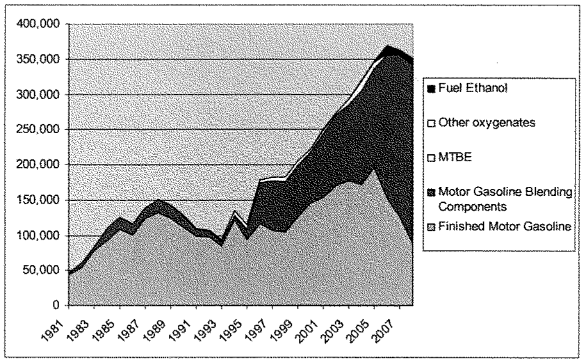
[2] Dr. Montgomery is Vice President of Charles River Associates and among other recognitions received the 2004 "Publication of Enduring Quality" award from the Association of Environmental and Resource Economists for his 1972 publication that laid the theoretical foundation for analysis of emission trading. Conclusions in this paper are his own and do not necessarily reflect those of Charles River Associates.

[3] An Analysis of the Potential Impact of U.S. Climate Legislation on the International Competitiveness of U.S. Refiners, no authors or source named

[4] Ibid. p. 4.

Figure 1: Gasoline imports into PADDI



Source: US Energy Information Administration, Form 814

Second, the statistic that domestic refiners produce 90% of refined products supplied in the U.S. says nothing about their ability to raise prices. Prices are determined by the marginal source of gasoline – the source where production will expand and contract when prices change. The Federal Trade Commission puts it that "The price of gasoline in [one area] is ultimately constrained by the price of the marginal supply of gasoline from another area]. ... Marginal supply is the swing supply that would enter the market if prices rose and exit the market if prices fell."[5]

Imports have been that marginal source for many years. The difference in cost between shipping products and shipping crude oil has narrowed, and large, new product tankers with lower cost are already appearing as Middle Eastern refiners start to serve more and more distant markets. Moreover, it is the shares of individual U.S. refiners that antitrust agencies use to measure market power, not the total share of all refiners, and by that measure the U.S refinery industry is not concentrated.

In its 2008 report, GAO concluded that the refinery industry overall in the U.S. was not significantly concentrated, and that imports of refined petroleum products were likely to negate the potential for refiners to exercise market power in the sale of gasoline. GAO analyzed the level of concentration among refiners operating in a number of regions of the United States: (i) the Pacific Northwest, (ii) the West Coast; (iii) the Gulf Coast; (iv) Chicago; (v) the Mid-Continent; and, (vi) New York Harbor. Refinery markets in the Gulf Coast and Mid-Continent regions were found to be not concentrated; refinery markets in the Midwest (Chicago), Pacific

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[5] Final Report of the Federal Trade Commission, Midwest Gasoline Price Investigation (Mar. 29, 2001), available at http://www.ftc.gov/os/2001/03/mwgasrpt.htm.

Northwest and West Coast regions were identified as moderately concentrated, with GAO noting that "West Coast regions have access to imported gasoline ... this clearly helps to mitigate potential issues of ... concentration." While GAO identified the New York Harbor region as highly concentrated, the "measure of concentration probably overstates the actual concentration [of] the market" because "foreign and Gulf Coast refineries ship a significant amount of gasoline into the East Coast." These shipments make the exercise of "market power ... lower than the HHI would indicate."[6]

The FTC 2006 large-scale investigation into the petroleum industry concluded that, nationally, the U.S. refinery industry is not concentrated. PADD level data also show that regional refinery markets are, with the exception of PADD I, not concentrated, or only slightly moderately concentrated. PADD I, which consists of refineries in the East Coast, is considered highly concentrated, but, as both the FTC and GAO recognize, imports of gasoline into PADD I (from the Gulf Coast and foreign sources) constrain refiners' ability to exercise market power.[7]

There is nothing wrong with the formula that the paper uses to calculate the passthrough percentage, but it is incorrect to use demand elasticity when imports are the marginal supply. The paper uses the formula to calculate how much of a cost penalty imposed only on U.S. refiners could be passed on to consumers, when competing imported products have no cost increase. As the FTC has pointed out, "Individual firms may have little or no market power even if industry demand is inelastic. It is a mistake to equate low demand elasticity with the ability of a firm to exercise market power."[8]

To calculate cost passthrough when imports are the marginal supply that constrains price increases, the elasticity of demand used in the formula should be replaced by the elasticity of supply of imported products. Based on the observation that product imports have increased dramatically even without this cost penalty, that elasticity of import supply is likely to be very large. With an import supply elasticity of even 5, indicating that a 1% cost advantage would lead to a 5% increase in imports, the pass-through would drop to below 10%.

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[6] United States General Accountability Office, Energy Markets: Analysis Of More Past Mergers Could Enhance Federal Trade Commission's Efforts To Maintain Competition In The Petroleum Industry at 27-29 (September 2008).

[7] Federal Trade Commission, Investigation Of Gasoline Price Manipulation And Post-Katrina Gasoline Price Increases at 25, 35 (Spring 2006), available at http://www.ftc.gov/reports/060518PublicGasolinePricesInvestigationReportFinal.pdf and United States General Accountability Office, Energy Markets: Mergers and Other Factors that Affect the U.S. Refining Industry 9-14 (July 15, 2004) (Testimony of Jim Wells, Director, National Resources and Environment, Before the Subcommittee of Energy and Air Quality, Committee on Energy and Commerce, House of Representatives); Federal Trade Commission, The Petroleum Industry: Mergers, Structural Change, And Antitrust Enforcement at 191 (August 2004), available at

http://www.ftc.gov/os/2004/08/040813mergersinpetrolberpt.pdf .

[8] Federal Trade Commission, Market Forces, Anticompetitive Activity, and Gasoline Prices: FTC Initiatives to Protect Competitive Markets at 15, n. 24 (July 15, 2004) (Testimony Presented By William E. Kovacic, General Counsel, Before the Subcommittee of Energy and Air Quality, Committee on Energy and Commerce, House of Representatives Hearing on the Status of the U.S. Refining Industry), available at http://www.ftc.gov/os/2004/07/040715gaspricetestimony.pdf .

However, there is a calculation for which the formula is relevant. That is for determining the passthrough of allowance costs to cover emissions from fuel use for which refiners are also responsible. Imported product is also subject to the requirement that the importer obtain allowances to cover CO2 emissions when the fuel is burned, so that the elasticity of demand for gasoline will determine the amount of cost passthrough. Despite an attempt to gloss this over,[9] the formula used in the paper is precisely the correct formula to use for calculating passthrough when domestic and imported fuels do bear the same cost.

The cost of allowances to cover these emissions would be approximately 8 cents per gallon, according to the same paper, so that ability to pass through only 65% of allowance cost would leave the refiner with an unrecovered cost of about 3 cents per gallon. Since the paper claims that the total cost of allowances for process emissions is about 1 cent per gallon, and that the 2.25% allocation would cover that entire cost, the paper's own formula applied to the 3 cent per gallon unrecovered cost leads to the recommendation that refiners should initially be allocated more than 6% of all allowances to cover their unrecovered costs associated with consumer use of fuels.

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[9] "...the passthrough rate would likely be significantly higher for the allowance costs associated with the carbon content of refined products, since that is a uniform cost across the entire industry and is applied to imports as well as to domestic production." Op. cit., p. 5.

Testimony of Van Ton-Quinlivan
Director, Workforce Development and Strategic Programs
Pacific Gas and Electric Company

Before the

Committee on Finance
United States Senate

Legislative Hearing on Climate Change Legislation: Considerations for Future Jobs

November 10, 2009

Chairman Baucus, Ranking Member Grassley, and Members of the Committee, I am honored to appear before you this morning to offer my views on workforce training and development issues facing the United States electric utility sector as we transition to a new energy economy.

I am Van Ton-Quinlivan, Director of Workforce Development and Strategic Programs at Pacific Gas and Electric Company (PG&E). PG&E is California's largest utility, providing electric and natural gas service to more than 15 million people throughout northern and central California.

Our work on energy efficiency, demand response and support of clean generating technologies is part of a broad portfolio designed to provide advanced energy solutions to our customers. To support these efforts, we have established programs aimed at ensuring that we have the workforce available to build, operate and maintain these vital resources.

As our sector looks ahead, we see an aging infrastructure, the advent of new power generation, electricity delivery and end use technologies, and a workforce with an average age ranging from the mid-40s to 50-years old. These demographics present a particular challenge to the industry because electric power employees traditionally retire at 55. In fact, over the next five years, 30 to 40 percent of electric utility industry's workforce is eligible to retire, and at PG&E, we expect that number to be closer to 40 percent. These expected retirements are from the ranks of workers needed to maintain our existing infrastructure and do not include workers needed to deploy and maintain new technologies and infrastructure.

We employ roughly 20,000 people -- administrative, management, construction, technicians, engineers, linemen, energy auditors, and others. PG&E, as with all utilities, provides a range of employment opportunities for workers with various skills and education levels. Utilities are unique in that we are located in every community across the country, from large cities to small towns. The need for a reliable stream of workers for our sector will touch every state and region of the country, some more than others.

At the same time, according to studies conducted by the National Commission on Energy Policy, Clean Edge, and Pew Charitable Trusts, not only will our sector need to replace a large segment of the existing workforce in the next five years, but we will also need to ensure that there is a workforce able to fill jobs in those sectors that support our industry, for example, welders, sheet metal workers, energy auditors, building maintenance engineers, accountants, and architects.

In fact, according to a study conducted by the Brattle Group, our industry is poised to make approximately $2 trillion in capital expenditures over the next 10 to 20 years to meet future demand and replace our current infrastructure. This investment will occur not only in power generation, but also transmission, distribution, customer service and energy efficiency. This is a significant amount of capital that will flow into our sector, and out. At the same time, we have seen an uptick in capital flowing to the clean tech sector. For example, along with investment flowing to biotech, software and medical devices, clean energy technologies alone saw $3.3 billion of venture capital flow toward it in 2008, according to New Energy Finance, with $13.5 billion flowing globally.

Before making these massive capital expenditures in infrastructure and the training programs to support them, clear direction from Congress is needed with regard to our nations' energy and climate policy.

Congress has taken many important steps in recent years that begin to provide our industry with that policy direction, including provisions in the American Recovery and Reinvestment Act to advance smart grid and renewable energy technologies and steps to rationalize critical energy tax policies, many of which this Committee and its members, in conjunction with others, helped to advance: renewable energy tax credits for solar, wind, hydroelectric, and other sources; innovative options that help monetize tax credits; bonus depreciation; and tax credits for energy efficient buildings, windows and appliances. These have all been critical and this infusion of resources has the potential to facilitate actions that will both drive technology and advance workforce training. However, many of these actions have been temporary or time-limited. And, for an industry that makes long-term capital decisions, deploys assets with long lead times, and has an employee turn-over rate that is below the national average, we need a clear, long term, national policy direction that builds off this strong foundation. Doing so will help unlock more of this investment and send the signal to our industry regarding the types of expenditures we need to make and the workers we will need to hire.

Some state policies have helped bring the country to the cusp of capitalizing on the development and deployment of new energy technologies. For example, according to Clean Edge, a host of start ups such as smart grid networking companies, high efficiency window and green building material providers and others have emerged in pockets around the country. This is in addition to renewable manufacturers and developers. We believe that state policies alone are not sufficient to expand these clean energy opportunities, including new nuclear, carbon capture and storage, significant new transmission and pipeline capacity, renewable energy – and see them materialize nationally.

In addition, training in the skills necessary to support the energy sector has not been a national priority for many years. It is no longer certain that this vital sector will be able to draw from a deep pool of highly skilled, technically trained individuals to build and maintain electric systems, particularly those based on new technologies or those that have not been deployed in decades. In fact, according to a report issued by the National Commission on Energy Policy (NCEP), in which PG&E participated, this capacity has eroded over the past two decades. As a result, the electric power sector is facing the challenge of having an aging workforce that is nearing retirement and a limited pool of skilled workers to fill open positions. Retirements in the electric sector have the potential not only to jeopardize the ability of the industry to maintain the nation's current electric infrastructure, but present great challenges in terms of having the skilled workforce to support next-generation technologies including power plant technologies, new metering technologies, and the back-office operations required to support them.

The NCEP Task Force on America's Future Energy Jobs (Task Force) brought together representatives from labor, the electric power industry, and the training and educational sectors to better understand and start to address these issues. Task Force members commissioned Bechtel Power, Inc. to provide estimates of the workforce needed to design and construct the new generation associated with a transition to a low-carbon economy. The Task Force members also estimated the workforce needed to build the supporting infrastructure for these next-generation, low carbon technologies, including transmission lines, pipelines, Smart Grid and energy efficiency. The group sought to move beyond anecdotes about "green jobs" to evaluate workforce needs associated with building and supporting energy infrastructure for a future low-carbon energy system, what the group called "future energy jobs". After estimating the future workforce demands, the group assessed the ability of the current workforce training system to meet this demand and made recommendations on how to better align workforce supply with workforce demand.

Key insights from that report are:

- *A decline in career and technical education has stressed the electric power sector's training capacity.* The career and technical education system, which prepared students to work in the skilled crafts, has declined in the past two decades. Since the mid-1990s, the number of high school students taking trade- or industry-related career and technical courses has declined 35 percent. As a result, individuals do not have the skills they need to succeed in apprenticeship programs or in-house training programs.
- *A large percentage of the electric power sector workforce is nearing retirement.* The electric power sector directly employs about 400,000 people, 30 to 40 percent of whom will be eligible for retirement or will leave the industry for other reasons within the next five years. Compounding this demographic shift, many workers appear to be delaying retirement due to the economic downturn, and this could create a larger disconnect if workers retire en masse when economic conditions improve.
- *Creating a low carbon energy system will require more workers with new skills.* In addition to replacing retiring workers, the industry will need an unprecedented number of skilled workers to design, construct, and operate the next generation of electric sector infrastructure. By the 2020's, design and construction in the electric power sector could require as many as 150,000 workers, roughly equivalent to 40 percent of the workforce employed to operate and maintain the current electric power sector. Similarly, by 2030, roughly 60,000 people will be needed to operate and maintain new generating assets, or 15 percent above the current workforce.

The overarching insight from this analysis is that, at present, the U.S. must focus on the dual challenges of transitioning to a low carbon economy and supporting the workforce needs resulting from a major domestic effort to accelerate investment in these new technologies.

The deployment of new technologies and generating assets will require new design, construction, operation, and maintenance skills. This is an important opportunity for new job creation and economic growth. If too few individuals with necessary expertise are available, however, workforce bottlenecks could materialize and the ability to take on workers at a sufficient pace could be slowed.

In fact, some economists are seeing this phenomena happening now in other sectors. John Silva, chief economist with Wells Fargo Securities, noted on November 6th that "There's a real mismatch between the unemployed people out there compared to what job openings are available." For example, he said construction workers who lost a job when the housing bubble burst do not have the skills to compete for jobs in sectors that are hiring, such as health care and technology.

It is this situation that we are working to avoid and on which the NCEP Task Force report is focused. PG&E has supported job training for decades both to help us and the broader industry. For example, we currently employ approximately 400 people who work on energy efficiency and demand response programs, and another 200 field staff in this area. This team works together with our customers to improve efficiency and save energy.

To ensure we have a workforce capable of delivering these services both in-house and through third-party contractors, we operate the following training facilities:

- PG&E Energy Training Center in Stockton, CA. This is the longest continually operating energy education center in the U.S., which has provided more than 68,000 people with hands-on training in installation, construction and energy audits.
- PG&E Food Service Technology Center in San Ramon, CA. This facility provides energy efficiency consulting and training to the food services industry.
- Pacific Energy Center in Can Francisco, CA. This facility provides energy efficiency education and training "upstream" to architects, engineers, and building operators and, in 2008, reached over 7,000 people.

Anticipating current trends, we launched the PG&E PowerPathway workforce development program in 2008, with a vision to build capacity in California to produce the skilled workers needed by PG&E and the energy and utility industry.

Inherent in the PowerPathway strategy is a commitment to have our employees reflect the communities we serve. We wanted a model of career pathways that could effectively lead candidates from all communities, including our underserved communities, to good energy sector jobs.

The PowerPathway model rests on a 3-legged stool where each party focuses on what it does best.

- The first leg is the employer. As an employer, PG&E focuses on articulating the skills that we need and on hiring.
- The second leg is outreach. We work with the Workforce Investment System which partners with local community-based organizations that have a role with economic development and therefore can do a better job of outreach into our communities, to pre-screen candidates and case manage them through the entire training process.
- The third leg is training. We work with local community colleges to develop custom curricula to help candidates be better prepared to compete for jobs in our industry.

Over the last two years, we have completed eight PowerPathway programs in five geographic regions throughout our service area. We have seen significantly improved diversity and quality of candidates due to the program. We have also transitioned veterans into our sector through the assistance of state grants and the help of the AFL-CIO.

These PowerPathway graduates qualified at an unprecedented level on PG&E's pre-employment test. And, over 50 percent of those who completed the pilot programs were hired by PG&E or its contractor partners—leading to positions with a starting wage of at least $19.50 per hour.

And, going forward, we will be doing even more. For example:

- In order to help our communities access ARRA funding for "green jobs" training as well as jump start their training, we will be sharing PG&E's 30 years worth of energy efficiency curriculum with the community college system through our PowerPathway Training Network in Energy Efficiency.

- We are investing in California State University-East Bay as a regional focal point to deliver certificate programs in the power engineering and Smart Grid arena. CSU-East Bay and PG&E jointly launched a new four-course Certificate in Power Engineering.
- We launched five high school academies in collaboration with the California Department of Energy. Our high school academies will be themed around the topic of "New Energy," in the hopes of introducing today's students to the wide applications of the academic skills to the world of energy careers.
- We are also expanding efforts to share best practices with other employers with the goal of having additional employers engage in a collaborative approach to workforce development. For example, PowerPathway was awarded a grant from the California Department of Veterans Affairs to train recently separated veterans through courses at City College of San Francisco and Fresno City College.

When it is time to hire, employers go to where the talent exists. Policies need to focus on establishing a pipeline of skilled workers. In the midst of a recession with growing unemployment, it was the collective view of the NCEP Task Force that it is imperative to get ahead of the curve, invest in our energy sector workforce, and ensure that we have the skilled workforce we need to achieve our long-term national energy objectives.

The NCEP Task force recommended:

- Evaluating regional training needs and facilitating multi-stakeholder energy sector training programs across the country.
- Improving energy sector workforce data collection and performance measurement metrics and tools.
- Identifying training standards and best practices for energy sector jobs.
- Providing funding support to individuals seeking energy sector related training and education.
- Aggressively focusing on revitalizing math and science skills, education and career counseling of individuals interested in pursing energy sector jobs.

We respectfully suggest that policymakers consider these recommendations when reauthorizing the Workforce Investment Act and when crafting energy and climate legislation.

We appreciate the efforts Congress has made thus far and are hopeful that the Senate will work expeditiously to craft a comprehensive energy and climate package with a focus on those provisions that can quickly transition workers into the new energy economy. Models are clearly out there and efforts are underway -- the challenge is to leverage existing programs and create the capacity needed throughout the country.

Thank you.

Senate Finance Committee
Climate Change Legislation: Considerations for Future Jobs
November 10, 2009
Responses to Questions for Van Ton-Quinlivan, Director, Workforce Development and Strategic Programs, Pacific Gas and Electric Company

Questions from Senator Baucus

1. **Several news recent reports indicate that China is making great strides in the development and manufacture of clean-energy technology. An August 2009 Christian Science Monitor article notes that Chinese factories already make a third of the world's solar cells – six times more than the U.S., and that last year China graduated 17 PhDs in the field of underground coal gasification, while only two others graduated in the rest of the world.**

   Please comment on China's green technology developments and the impact these will have on green technology and jobs in the United States. Please also share your thoughts on the U.S.'s opportunity to engage in similar technology development and job creation, such as through incentives like the new advanced energy manufacturing credit Congress passed in February.

   From observations through the media as well as our participation in the U.S.-China Energy Efficiency Alliance, it is clear that the Chinese are making significant strides toward developing and deploying clean energy technologies and practices.

   The effect of China's actions to advance clean-energy technologies may lead to further expansion of jobs and technologies going to or coming from abroad. The Chinese have prioritized clean energy technology development and deployment both through policies and investments.

   To compete effectively, it is critical that the U.S. also provide long-term policy and investment certainty for clean energy technologies. For example, a long-term extension of tax credits, loan guarantees, and grants provides greater assurance to investors and developers that will help drive growth in domestic industries and technologies. Many sectors, including the electric utility industry, are looking to make a number of investments that will create jobs and expand clean technology development, but many of these same sectors are hesitating or potentially looking to expand outside the United States because of difficult and time-intensive review/permitting processes and incomplete policy and investment guidance that would come from comprehensive energy and climate legislation.

   Furthermore, it's important that we invest in developing the entire continuum of skilled workers for the energy sector. Specific to competing at the R&D level, we need to revitalize advanced degree programs (Masters, PhDs) for the sector and ensure that they are focused on areas aimed at delivering technological breakthroughs. This includes providing incentives for students and faculty to pursue those domains of knowledge. In addition, growing the number of Professional Science Master's (PSM) in the energy field can increase the number of competent managers with the technical backgrounds to oversee technology projects. PSM programs are designed to provide students with advanced training in the sciences without a Ph.D. and pertinent business skills without an M.B.A., and they also emphasize written and verbal skills that are highly valued by employers when hiring traditional science students.

2. **Through the right clean energy policies, there is a potential to create thousands of new jobs in the U.S. We know there are various sectors that could experience job growth, but we need to have a skilled workforce in place to meet the demand. How do we ensure our workforce is trained and ready to seize these new opportunities? And as new technology is developed, how do we ensure our training programs equip Americans with durable, in-demand skills? How would you suggest we address the need to keep newly acquired skills fresh?**

   Programs like PG&E's PowerPathway™ program demonstrate how purposeful collaborations can provide the training necessary for workers to possess in-demand, durable skills valued by the industry. When industry, educational institutions, and the workforce development system collaborate, the result is a more responsive system that leverages resources and minimizes duplicative efforts as we all adapt to changing workforce needs.

   The energy industry provides a wide range of advancement opportunities for its workers, but all skilled technician positions require some level of postsecondary education that includes pre-apprenticeships, technical certificates, associate degrees and bachelor degrees. With additional training come opportunities to take on higher-skilled work and earn higher pay. Key to this effort is the development of a more standardized approach to skills and credentials in the industry as well as the development of a highly responsive network of educational providers. The development of a system that supports common competencies and curriculum will provide a more cohesive energy education system. Moreover, this systems approach must be employer-informed so that as the demand for skills shift, the programming also shifts accordingly.

   The Center for Energy Workforce Development (CEWD), in partnership with US DOL, has developed an Energy Competency Model that defines basic competencies, industry fundamentals, industry technical competencies and job specific competencies in eight separate tiers. Each tier of the competency model leads to the next and mastery of each level is required for success.

   Grouping the skills into tiers allows for the development of common curriculum and education requirements. This system of "stackable credentials" includes assessments to validate knowledge and skills learned in the classroom as well as on the job, resulting in industry-recognized credentials that are transportable from one company to another. It also allows for flexibility and pathways for career advancement.

The education network institutions need to be encouraged to offer the stackable credentials, connections between high schools/community colleges/four-year institutions, and flexible delivery systems such as online learning, as well as innovation to accelerate learning and assess prior learning. These sets of activities need to be informed by the needs of industry.

Lastly, clear federal policy on climate and energy priorities will go a long way toward providing necessary guidance that helps ensure workforce development training is relevant and moving in the right direction.

Questions from Senator Cantwell

1. **In addition to thinking about the costs of policy action on climate change, we need to be just as aware of the potential costs of inaction. There is going to be tremendous energy growth, particularly in the developing world, over the next century. Energy is already a $6 trillion market, and it is growing fast. I want to be sure that the United States is the world's leading supplier of clean energy technologies to meet the exploding world demand.**

   - **How should policymakers create and structure incentives that enable US leadership in clean energy technologies? Is a consistent, stable price on fossil carbon an effective or necessary component?**

     At PG&E, we believe the most efficient, cost effective and environmentally certain way to address climate change is through comprehensive federal cap and trade legislation that places a price on carbon and that also includes complementary policies for technology research, development and deployment, lower carbon transportation technologies and systems, and improved energy efficiency in buildings, industry and appliances. Certainty around carbon emissions targets and pricing provides a critical economic signal and long-term roadmap necessary to spur investment in new technologies, infrastructure and business processes.

   - **How do you think we should balance the protection of existing industries with the promotion of future industries? Isn't there a real risk that if we fail to create the right investment incentives at home, we may miss out on the lucrative opportunities that will accompany global leadership in clean energy?**

     Transitioning to a lower-carbon, energy efficient economy is vital not only to address the enormous challenge of climate change, but also to ensure our nation's national and energy security. Comprehensive climate and energy policy should be developed in a way that ensures America's existing industries will lead globally both during and beyond this transition. Critical policy design elements should include:

     - Emissions reduction targets and timeframes that allow for a slow, stop and reverse trajectory to enable existing industries to transition without making it attractive to shift operations overseas;
     - Cost containment tools such as offsets, allowance allocations and a price collar that protect businesses and consumers from price shocks that would

undermine the sustainability of comprehensive climate change policy and sideline critical investment in new technologies;

- Investment in research, development and deployment that facilitates American innovation and leadership in the development of new low-carbon technology and energy efficient infrastructure; and,
- Allowance allocation that guards against energy prices spikes for consumers, e.g., providing allowance value to electricity consumers via regulated local distribution companies, as well as allowances to help buffer the transition to trade exposed and energy intensive industries. We believe an allowance allocation system must return value to end use energy consumers, and that there are a variety of mechanisms by which to do that, including direct rebates to low- and moderate income consumers, rebates delivered directly on customers' energy bills and allowances provided to those with a compliance obligation. In addition to returning allowance value to households and businesses, we also believe it is critical to support the development and deployment of clean energy technologies, both to help bring down the cost of these technologies and help spur job creation.

2. **One of the most important ways we can stimulate economic growth and job creation through climate policy is by creating consistent price signals and long-term incentives for investment in innovation and new energy technologies.**

- **In any policy involving the auctioning of emissions allowances, do you think that price controls—both price floors and ceilings—are necessary to manage volatility and uncertainty?**

PG&E strongly supports a price collar, with environmental integrity, as a critical policy tool to manage volatility and uncertainty within a cap-and-trade program. In order for businesses and investors to have the confidence to make long term capital investment decisions necessary to achieve the targeted emissions reductions, carbon prices need to predictable and stable. Volatility and uncertainty in carbon prices ultimately will cause the overall cost of a cap-and-trade program to be much higher than what is acceptable or sustainable to businesses and consumers.

- **Would a well-designed, price collar (i.e. explicit upper and lower bounds for the price of allowances) provide sufficient assurances for substantial investment in capital-intensive, low-carbon energy systems such as CCS and nuclear, as well as other, more conventional?**

A well-designed price collar provides a necessary foundation for substantial investment in both capital-intensive, low-carbon technologies such as CCS and nuclear as well as more conventional energy systems and infrastructure. Without the price predictability facilitated by a price collar, capital investments may be delayed or much more expensive, which would ripple through the economy hurting both businesses and consumers. However, a price collar alone will not provide sufficient assurances for the capital investments necessary to transition to a lower-carbon economy. A price collar must be coupled with other complimentary policies such as loan guarantees and tax credits to accelerate the development, demonstration and deployment of existing or imminent low-emitting technologies.

3. **In your opinion, are the workforce and job training provisions in the energy bill moving through Congress sufficient, or do we need to do more? Is there anything else we can do, particularly regarding the community college system?**

The Senate's energy bill provides a good base for expanding federal support for workforce and job training programs. As we have seen through our PowerPathway™ program, meaningful results can be achieved when partnerships are created between diverse stakeholders – such as private industry, workforce development organizations, and institutions of learning – whom all want to expand the number of highly skilled workers needed for a cleaner energy future.

Specific to the bill's provisions, energy career academies should include a hands-on lab as part of its stated curricula as well as how this curricula ties in with the Energy Competency Model articulated by the Center for Energy Workforce Development in order to ensure that efforts are utilizing effective models that have already been developed for training a skilled energy industry workforce. For trades programs that utilize community colleges, we would again emphasize the role that hands-on lab exercises can play in these training programs.

With respect to career coaching and outreach, it's important that duplicative efforts not be created and that programs and communications be coordinated through the many industry workforce consortiums already working in states in cooperation with educational partners. This also applies to coordination of energy workforce training programs, whereby additional personnel at State Energy Workforce Consortiums could facilitate coordination between industry and education partners. Also, to the extent that existing work is underway through organizations like the Center for Energy Workforce Development, it is preferable to support and leverage their efforts than start anew.

For awards targeting a Sustainable Energy Training Program at Community Colleges, we suggest that additional focus be highlighted to encourage the training needs of industry to "upskill" their current workforce in addition to the public-at-large. Industry can also help advise curricula development in this regard or curricula could be aligned with an industry-recognized credential.

Lastly, we highly recommend that references to duration requirements of training programs at higher education institutions be lowered from 10 years to 5 years to better focus on immediate needs of the energy industry.

Questions from Senator Menendez

1. **Over the last thirty years California reduced its per capita electricity consumption to 40% below the national average. This saved households $56 billion and created 1.5 million additional jobs in California. How is PG&E helping to implement renewable energy sources and reduce electricity consumption?**

PG&E has developed a comprehensive and holistic approach to expanding renewable energy sources and reduce energy consumption. In fact, even with our success in California, we still see energy efficiency meeting approximately 50% of our future load growth over the next 10 years and see the expansion of renewable energy sources helping to increase the diversity of the mix of energy we deliver.

California's "loading order" prioritizes the way PG&E delivers energy by focusing on energy efficiency, demand response, renewables, and distributed generation (in that order) before traditional generation is utilized.

We also have found great value in California's "decoupling" revenue structure and incentive mechanism. Decoupling essentially breaks the link between revenues and earnings while the performance incentives provide a string mechanism to encourage PG&E to not only meet, but exceed energy efficiency targets. Decoupling ensures that utilities collect no more and no less than the revenues necessary to run their business and provide a fair return to investors. The end result is a policy that facilitates smart energy priorities like energy efficiency.

Our energy efficiency program focuses on integrated energy management solutions tailored to meet our customers' specific needs. With a nearly $1 billion budget, PG&E's program is comprised of 85 distinct programs and includes financial rebates and incentives, energy audits and analysis, education and training, emerging technologies projects, codes and standards advocacy, marketing and outreach, and evaluation and verification. PG&E has approximately 600 employees that focus on energy efficiency and work with hundreds of contractors that employ thousands on people throughout the state.

PG&E also operates training centers to help educate our contractors, employees and customers about energy saving processes, technologies and practices. For example, our training center in Stockton, California, is the longest continually operating energy education center in the U.S. and has provided more than 68,000 people with hands-on training in installation, construction, and energy audits.

With respect to renewable energy sources, we continue to expand our activities to develop, generate, and purchase additional renewable energy. Technologies represent a diverse array of sources, including solar, wind, geothermal, hydroelectric, biomass, wave/tidal, and "cow power" (i.e., utilizing methane from animal waste). As noted above, long-term certainty for renewable energy incentives is critical to advance these technologies.

PG&E also supported the establishment of the California Solar Initiative, helping to create the largest domestic market for rooftop generation by establishing declining-rate incentives that reduce the upfront price for consumers and capture lower costs from increased volume through economies of scale.

COMMUNICATIONS

American Petroleum Institute
Statement for the Record
of the
Senate Finance Committee hearing
Climate Legislation: Considerations for Future Jobs
November 10, 2009

The American Petroleum Institute is pleased to submit comments on Senate climate change legislation and its potential impact on jobs. API is a nationwide trade association representing nearly 400 member companies involved in all aspects of the oil and natural gas industry in the United States. API members believe climate change is a serious issue and are working to reduce greenhouse gas emissions. They are improving the energy efficiency of their operations, investing in development of clean-burning natural gas, reducing natural gas flaring, and developing and refining other low-carbon and carbon sequestration technologies. Since 2000, U.S. oil and natural gas companies invested more than $58 billion in greenhouse gas mitigation technologies – or nearly half the national total – according to a recent study by T^2 and Associates and the Center for Energy Economics at the University of Texas.[1]

API supports cost-efficient, market-based strategies for reducing greenhouse gas emissions and believes costs should be fairly distributed across society. However, the Kerry-Boxer cap-and-trade bill, like the similar Waxman-Markey bill passed this summer by the House, is seriously flawed. Both bills could sharply increase energy costs for families – with disproportionately heavy impacts on consumers of gasoline, diesel, jet fuel and other petroleum fuels. Both also could destroy millions of American jobs, even after creating some green jobs. The prospective job losses are especially troubling given the serious long-term challenge of reemploying the more than 15 million Americans now out of work, many forced into the unemployment lines as a result of the recession.

Several studies of proposals to address climate change warn of substantial job losses:

- The Energy Information Administration projects net job losses up to 2.3 million in 2030 for the Waxman-Markey bill, which is less aggressive and has lower costs than Kerry-Boxer.[2]

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[1] *Key Investments in Greenhouse Gas Mitigation Technologies by Energy Firms, Other Industry and the Federal Government: An Update*, June 2009.

[2] *Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009*, August 2009.

- The National Association of Manufacturers and American Center for Capital Formation project net jobs losses up to 2.4 million in 2030 for the Waxman-Markey bill.[3]
- CRA International (for the National Black Chamber of Commerce) estimates a net reduction of up to 2.2 million jobs in 2030 from Waxman-Markey.[4]
- The Heritage Foundation projects a net loss of nearly 2.5 million jobs in 2035.[5]
- The Brookings Institution projects up to a one-half percent reduction in jobs based on analysis of a range of cap-and-trade scenarios.[6]

While the Congressional Budget Office estimates more modest job losses for Waxman-Markey, it does not attempt to fully evaluate employment impacts. Most significantly, it fails to take into account the impact on jobs from higher energy prices and less economic growth. CBO says, the "reduction in GDP would ... include indirect general equilibrium effects, such *as changes in labor supply* [emphasis added] resulting from reductions in real wages and potential reductions in productivity of capital and labor."

Kerry-Boxer could eliminate jobs because it would increase the cost of energy throughout the economy. Businesses forced to pay more for energy may increase prices for the goods and services they provide and/or eliminate jobs, and, as the price increases rippled through the economy, more jobs could be lost. Also, if energy prices rise, consumers may have less to spend on other goods and services, putting jobs at risk held by people producing them.

Some eliminated jobs could be exported, including some of the more than 9 million jobs supported by America's oil and natural gas industry. Kerry-Boxer, like Waxman-Markey, could force U.S. refiners to pay hundreds of billions of dollars annually for allowances covering consumer emissions plus tens of billions annually for their facility emissions, placing them at a competitive disadvantage with foreign refiners not subject to the same requirements. A study by EnSys Energy projects that in 2030 Waxman-Markey would reduce U.S. refinery throughput by 27 percent and U.S. refinery investment by 88 percent.[7] This could lead to the destruction of tens of thousands of U.S. refinery and construction jobs while forcing America to turn more to foreign refiners for the gasoline and other fuels they require. Thus, more foreign workers would be employed to make fuel some American workers once made. The shift to foreign refineries would move greenhouse gas emissions offshore rather than reduce them.

Despite what most studies show, proponents of the House and Senate bills still contend that massive numbers of new green jobs would be created, more than making up for negative impacts on the economy. Of course, some green jobs could be created by forcing out traditional sources of energy while also massively subsidizing renewable sources. However, if renewable energy remains relatively more expensive than conventional fuels, Americans could buy less, undermining job growth in the renewable energy industry. Moreover, the cost to the economy – and taxpayers – for creating each new green job could be enormous, and many of the jobs created might go to foreign workers.

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[3] *Analysis of the Waxman-Markey Bill, the American Clean Energy and Security Act of 2009 (H.R. 2454)*, August 2009.

[4] *Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R. 2454),* August 2009.

[5] *Son of Waxman-Markey: More Politics Makes for a More Costly Bill*, May 2009.

[6] *Consequences of Cap and Trade*, June 2009.

[7] *Waxman-Markey (H.R. 2454) Refining Sector Impact Assessment*, August 2009.

A study of Spain's climate change/green jobs program by Dr. Gabriel Alvarez of Universidad Rey Juan Carlos and coauthors supports skepticism about green jobs.[8] It concludes that for every green job created in Spain, more than two traditional jobs were lost. The study also shows that it cost a lot to put traditional job holders out of work. The Spanish government paid more than $750,000 in subsidies to create every green job – and more than $1.3 million for every wind energy job.

A study of Germany's green jobs program by the Institute for Energy Research found that German taxpayers were paying about $240,000 to create each green job.[9] Recent news reports suggest Germany intends to dramatically reduce subsidies to renewable energy to address budget issues during the economic downturn.

A "Good Jobs First" report, commissioned by unions and environmental groups, found that many U.S. solar and wind companies are outsourcing the manufacture of solar modules, wind blades, and solar panels to factories in China, Mexico, Malaysia and other foreign nations.[10] U.S. wind turbine imports rose from $60 million in 2004 to $2.5 billion in 2008. New green jobs can help U.S. employment but only if they occur in the U.S. Nothing in the Kerry-Boxer bill prevents further loss of renewable industry jobs to foreign manufacturers, although if such provisions could be and were added, the likely result could be even higher costs for consumers of renewable energy.

The vast preponderance of analysis of Kerry-Boxer shows it would threaten millions of American workers and put our economy in low gear. Kerry-Boxer is the wrong answer for addressing climate change. Congress should work with all stakeholders to develop a better approach.

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[8] *Study of the effects on employment of public aid to renewable energy sources*, March 2009.
[9] *Strike Three: First Spain, Then Denmark, and Now Germany*, October 2009.
[10] *"High Road or Low Road," Job Quality in the New Green Economy*, February 2009.

ASSOCIATION OF
AMERICAN UNIVERSITIES

ASSOCIATION OF
PUBLIC AND
LAND-GRANT
UNIVERSITIES

Statement for the Record
by
Peter McPherson, Association of Public and Land-grant Universities, and Robert M. Berdahl, Association of American Universities

Senate Finance Committee Hearing: "Climate Change Legislation: Considerations for Future Jobs"
November 10, 2009, at 10:00 a.m.

Dear Chairman Baucus and Ranking Member Grassley:

On behalf of the Association of Public and Land-grant Universities (APLU) and the Association of American Universities (AAU), we offer comments for the November 10, 2009 hearing record from the research university perspective on a Senate counterpart to H.R. 2454, "The American Clean Energy and Security Act" (ACES Act).

The combined membership of APLU and AAU includes most major public and private research universities in the United States. Despite budget constraints brought on by state government cuts and declining endowments resulting from the current fiscal crisis, our universities are already seriously engaged in producing the intellectual talent, the scientific breakthroughs, and the new energy technologies required to help meet the huge energy and environmental challenges facing our country. We would like to work with the Federal government to contribute more.

Unfortunately, our nation and the rest of the world have been woefully under-investing in energy research and development for almost three decades. Today our federal energy R&D expenditures are just one-fifth of their 1980 peak as a percentage of GDP. Indeed, since 1980 the U.S. federal investment in energy R&D has dropped from 10 percent of total government R&D investments to just two percent today. This underinvestment has left our current knowledge base and our available clean energy technologies inadequate to tackle the looming energy and climate challenges.

Achieving necessary new energy and environmental goals will require replacing virtually every energy technology used worldwide today at a cost that the International Energy Agency (IEA) has predicted will reach trillions of dollars. For us to have a reasonable chance of meeting these goals and avoiding significant environmental degradation, U.S. energy companies must become as research-oriented as high-tech companies are today. At the same time, the U.S. government must immediately increase its commitment to investing in long-term energy research critical to our energy future.

We were encouraged when the President said in his February 2009 address to Congress, referring to cap and trade revenues, that "we will invest $15 billion a year to develop technologies like wind power and solar power, advanced biofuels, clean coal, and more efficient cars and trucks built right here in America." We are further encouraged that Secretary of Energy Steven Chu has said repeatedly that to meet the climate change challenge, government spending on energy R&D must move to the levels of high-tech industry, which are generally 10 percent or more of sales. Both realize that technological change must be preceded by the increased knowledge that can only come from a substantial research and development effort.

The only way for Secretary Chu's vision to move forward at a credible pace, however, is for the Congress to honor the President's request. Unfortunately, both the House-passed bill and the Senate versions to date have failed to do this. As Presidential Science Advisor John Holdren noted in a September 24 National Journal interview, "...in my judgment, one of the things I would have preferred to see in the House bill that wasn't really there, was a lot of support for energy technology and innovation. In principle, that could be fixed in the Senate and in conference." This is a gentle way of saying that the House-passed bill managed to spread tens of billions of dollars per year on a wide variety of energy and environmental causes while virtually ignoring the research investment necessary to solve our energy and environmental problems; the draft Senate Environment and Public Works Committee bill also appears to ignore the Administration's call for R&D.

As the Senate moves forward with climate change legislation, we strongly urge you to ensure that the amount of R&D funding designated for the development of clean energy technologies is more in line with the President's proposal of $15 billion. We further encourage Congress to designate approximately a third of these funds to support early-stage basic, applied and transformational research and to expand energy education and workforce efforts. Finally, we recommend that Congress front-load this R&D investment in the climate legislation to ensure that we have the required research breakthroughs and new technologies available in time to successfully meet the bill's targets for greenhouse gas emission reductions.

We commend you for your leadership in advancing the innovation agenda in Congress. We are grateful for the continued incremental increases in appropriations for basic research that reflect the goals of the America COMPETES Act and the President's budget. These increases on their own will bring us only a fraction of the way to solving our energy research deficiencies. We agree with the President that a directed revenue stream from climate change mitigation legislation is the best way to address this problem.

A one-page fact sheet with more information on our proposal is attached.

Sincerely,

Peter McPherson
Association of Public and Land-grant Universities

Robert M. Berdahl
Association of American Universities

PROPOSED RESEARCH FUND TO MEET GOALS OF CLIMATE-ENERGY BILL

In both the House and Senate current climate-energy legislation, there is a call for an 83% reduction in US carbon emissions by the year 2050. **Without significant advances in science and technology, the incentives now provided in both major climate bills being considered by Congress are not sufficient to let the US meet its goals.** Many studies have recommended major increases in both Federal and private sector energy R&D to do this; thus the President, in his FY10 Budget, calls for creating a "Clean Energy Technology Fund" of $15 billion per year for 10 years. We need a major effort to obtain the basic scientific knowledge to develop and implement the technologies needed to eliminate the projected growth in the use of fossil fuels, and then to displace five of every six barrels of oil and tons of coal with renewable and nuclear energy, and enhanced energy efficiency.

Secretary Chu has said that to achieve dramatic change in our energy portfolio, energy companies will have to become high technology companies and substantially increase their R&D investments. This will not happen without accompanying large increases in Federal energy research conducted at universities and other major research institutions – where most cutting edge research is done - so they can become major sources of new technologies, of spinoff companies, and of the highly trained workforce needed for the transformation of our energy economy. We also will require a highly trained workforce for energy production, installation and maintenance, as well as for development and implementation of new codes and standards. **To increase the chances for rapid success, the research and training must be frontloaded**. The longer it takes for dramatic improvements in energy technologies to occur, the less likely it will be for Americans to make our necessary contribution to reducing fossil energy use and dependence, and the required reductions in the cost of new energy technologies.

Consistent with the Administration's proposal, we recommend that a modest portion of the climate change mitigation allowances – one third of the President's request, about $5 billion – be allocated to conducting the research necessary to accelerate the invention, development, and deployment of the new technologies we need, and to increase our understanding of climate change. Making these dramatic changes will require such an increased research effort in energy production and consumption which account for nearly 10% of our GDP. This proposal is only **one** of many ways to structure such an effort.

Proposal for Discussion

- Seven percent of the carbon allowances issued annually (nearly $5 billion in FY 2012, as estimated by CBO) shall be used to fund basic and long-term applied research to support the goals of the legislation.
- An account shall be created in the Treasury named the American Clean Energy Research Fund.
  - For each of the fiscal years 2012 through 2014, in exchange for these allowances, the Treasury shall deposit in the Fund an amount equivalent to their value, as estimated by CBO prior to enactment; **this will let the research start as soon as possible.**
  - For fiscal years after 2014, the annual proceeds from selling the allowances will be deposited in the Fund.
- Funds from the Research Fund, on enactment, shall be available for obligation subject only to such limitations as may be placed in appropriations acts enacted after this legislation. Specific program authorizations could be set forth in quadrennial authorization bills starting the calendar year after the enactment of the legislation.
- Funds from the Research Fund shall be used only for competitively awarded basic research or long-term applied research in the following areas:
  - new lower, or zero, carbon emission energy resources and technologies, including increased efficiency;
  - improved methods for sequestering greenhouse gases;
  - climate change research, including its modeling, monitoring and analysis; and
  - the economic and social factors affecting consumer energy use.
- The Secretary of Energy shall oversee the Research Fund and prepare an annual plan for obligating its funds; he shall present it to the Congress at the same time the President submits his annual budget request.
- To the maximum extent practicable, multiyear projects funded from the Research Fund shall be fully funded at their initiation; such projects shall be reviewed by DOE on an annual basis.

Financing Energy Efficiency

By Daniel M. Kammen, TKTK

Home and business owners could pay for clean energy technology through their property tax bills

THE OBAMA ADMINISTRATION WILL need a truly diverse set of tools to lead the nation to a low-carbon economy. To date, the U.S. effort has focused largely on technology and policy solutions that would reduce energy consumption and increase renewable energy supplies. But very little attention has been given to how to finance these desirable changes. A major monetary (and psychological) barrier for many people is the high up-front cost of new installations. How many of us would have cell phones if we had to pay for 20 years of minutes at the outset?

One energizing solution has emerged from a simple observation: municipalities routinely lend money for residential upgrades that benefit individuals and the community, such as putting power lines below ground. Why not do the same for clean energy? Berkeley, Calif., has pioneered such a program, called the Financing Initiative for Renewable and Solar Technology. It allows residential and commercial property owners to install improvements in their buildings. The city pays the up-front expense, and the individuals pay that back through a special fee on their property tax bills, spread over 20 years. Any repayment that remains when a property is sold transfers to the next owner. Boulder, Colo., Burlington, Vt., Austin, Tex., and other locations are considering similar programs.

The Berkeley loans, made at low interest rates (4 or 5 percent, depending on how federal lending rates change), will first go to property owners for installing needed energy-efficiency improvements, such as tankless hot-water heaters, energy-saving windows and high-efficiency lighting. The owners can then advance, if they want, to installing rooftop solar power systems. Trials with the solar component are already under way.

Daniel M. Kammen is founding director of the Renewable and Appropriate Energy Laboratory at the University of California, Berkeley, and is a professor in the school's nuclear engineering and public policy departments.

Although municipalities must examine the effects of such a program on the local property tax structure, the results can be striking. At current rates, owner savings on utility bills would offset part of the loan costs, and as energy prices rise—especially as governments implement carbon taxes or cap-and-trade systems—the savings could outweigh the loan payments.

Of course, levels of greenhouse gases would fall. Nationwide, if only 15 percent of residential property owners took advantage of such programs, the emissions reductions would contribute 4 percent of the savings needed for the U.S. to reach 1990 emissions levels by 2020—all at no net cost to local, state or federal governments because owners pay back the loans. Large, additional savings would accrue if the program were extended to commercial buildings. My laboratory has developed an interactive Web site for evaluating the energy and carbon benefits: http://rael.berkeley.edu/berkeleyfirst.

Federal and state involvement could greatly expand the model or eliminate some of the barriers that cities might face in implementing such programs on their own—chiefly, where do *they* get the up-front money? So far they have floated bonds. Federal and state governments could either support city programs or directly finance the upgrades; their bonds would be more efficient because they would cover larger populations.

Programs such as Berkeley's, which I like to call "clean energy municipal financing," open a new door to the future.

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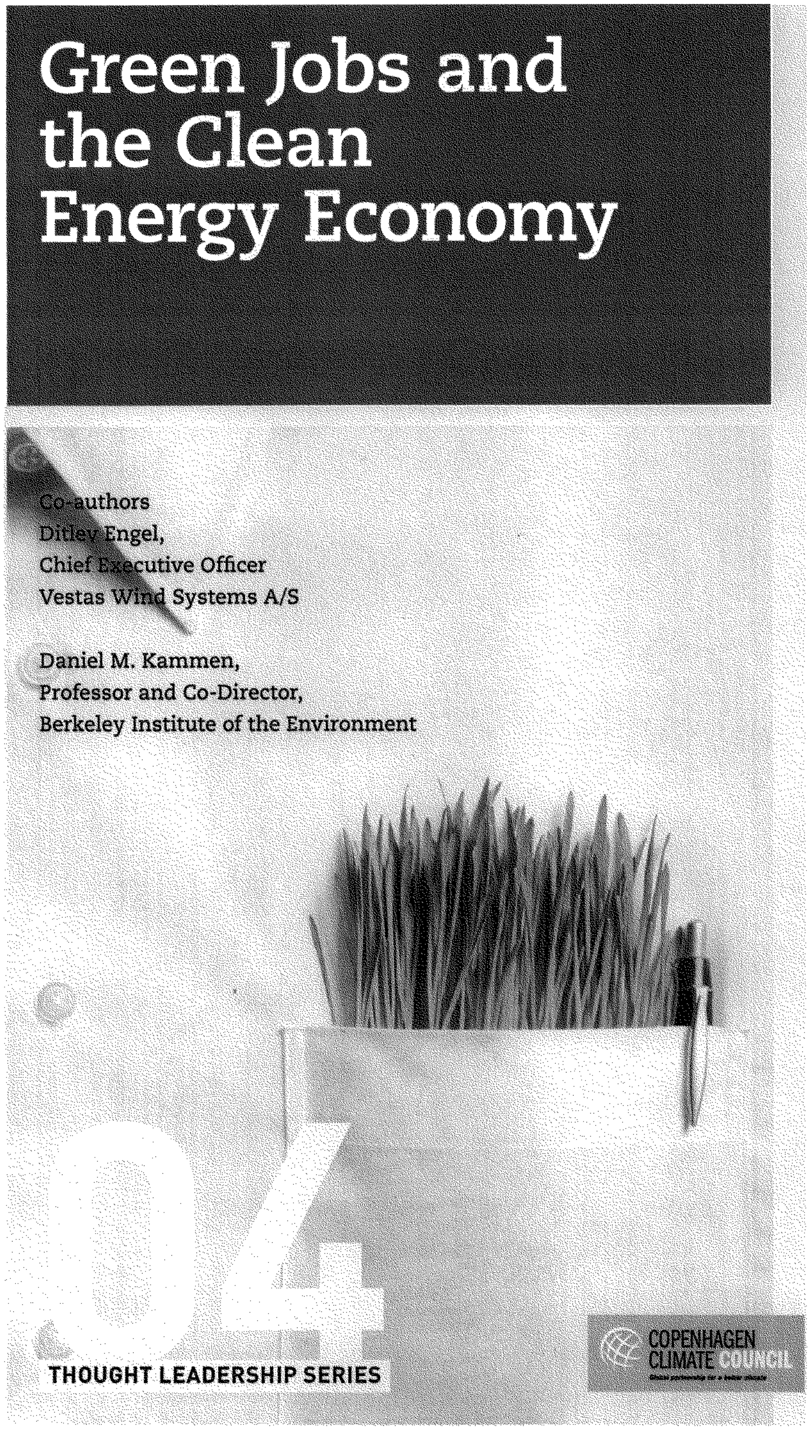

Green Jobs and the Clean Energy Economy

Co-authors
Ditlev Engel,
Chief Executive Officer
Vestas Wind Systems A/S

Daniel M. Kammen,
Professor and Co-Director,
Berkeley Institute of the Environment

04

THOUGHT LEADERSHIP SERIES

COPENHAGEN CLIMATE COUNCIL

About the Series

The Copenhagen Climate Council's Thought Leadership Series are inspirational, concise and clearly argued essays from leading investors, scientists, urban planners, entrepreneurs, experts, CEOs and policymakers on elements important to the development of a new global climate treaty. Communicating potentials and opportunities inherent in tackling climate change, the Thought Leadership Series aims to enhance public and political awareness of solutions promising significant impact on global emissions growth.

These essays will input into the World Business Summit on Climate Change on 24-26 May 2009 that will send a strong message to the 2009 UN Climate Change Conference (COP15) in Copenhagen. The message will include how to remove barriers and create incentives for implementation of new solutions in a post-Kyoto framework. This event is hosted in cooperation with the following key partners:
UN Global Compact, World Business Council for Sustainable Development, World Economic Forum, 3C and Climate Group.

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Green Jobs and the Clean Energy Economy

Co-authors

Ditlev Engel,
Chief Executive Officer
Vestas Wind Systems A/S

Daniel M. Kammen,
Class of 1935 Distinguished Professor of Energy
Founding Director, Renewable and Appropriate
Energy Laboratory
Co-Director, Berkeley Institute of the Environment
University of California, Berkeley

With
Max Wei and Shana Patadia
Energy and Resources Group and Haas School of Business,
University of California, Berkeley

And
Cassia Simons Januario
Vestas Wind Systems A/S

Thought Leadership Series #4

Green is the new blue... blue collar, that is

The clean energy industry has been targeted as a key area for investment for three primary reasons: greater energy independence, improved environmental benefits from reduced greenhouse gas emissions and significant, positive economic impacts. Job creation is an especially pressing issue as we confront both our climate responsibilities and the opportunity to build a low-carbon economic base. The development of indigenous sources of clean energy will spur the creation of more jobs locally than 'business as usual' fossil-fuel economies of the last century, while investments in energy efficiency measures will redirect money otherwise spent on energy costs, reduce emissions, and create a large number of jobs. Sensible investment in renewable energy will build a foundation for economic stability, sustainability, and growth.

Understanding potential job creation is a vital component of any effort to invest in the clean energy economy. The main findings of the study shared herein are based on quantitative analysis of job creation data for the major renewable energy technologies and qualitative analysis of a few key industries. They indicate that the renewable energy sector generates more jobs per unit of energy delivered than the fossil fuel-based sector, and that many sectors can contribute to both very low CO2 emissions and significant job creation. The discussion of the wind energy industry also draws upon the example of the world's largest wind energy company, Vestas.

The clean energy imperative

The findings of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) suggest that an 80-95% reduction in industrialized countries' greenhouse gas (GHG) emissions from 1990 levels by the year 2050 is required in order to reduce the risk of dangerous and potentially catastrophic climate change[1]. To make this goal achievable and to minimize the cost of later and inevitable action, we believe emissions should be reduced by 25-40% by industrialized countries over the coming decade while rapidly industrializing countries must learn from the experiences of those more developed nations and engage on less carbon-intensive paths to development. As a whole, global emissions need to peak and begin to decline in the next decade.

Reducing emissions as early as possible has many advantages. The Stern Review details the benefits of strong, early action to address climate change and underscores how the costs associated with progressive climate policy in the short term will impact GDP to a far lesser degree than delaying action into the future.[2] Stern and colleagues go on to say that now is the right time to invest in measures that promote low-carbon technologies, both on account of climate change and the current economic situation. This would effectively create jobs in the near term and avoid 'locking in' high GHG-emitting facilities for decades to come.[3]

Policy conditions to enable renewable energy

The electricity sector is responsible for 40% of worldwide carbon dioxide emissions, and these emissions are projected to continue rising.[4] As such, finding reliable sources of low-carbon energy will be imperative if nations are to have any hope of decoupling economic growth from emissions growth.[5] Renewable energy can be a driver for economic development and employment as the achievement of a low-carbon and more sustainable economy will likely increase demand for labor and result in the net creation of jobs.[6] Enabling this outcome, however, requires the implementation of certain policies and measures. These include:

- Long term government commitment to specified and ambitious renewable energy targets;
- Financial support in order to ensure that targets are reached;
- Access to transmission infrastructure and strategic expansion of this infrastructure;
- Streamlined planning and permitting procedures.

These policy signals deliver the message that governments are serious about addressing climate change and enable the robust capital expenditure investment required to meet the scale of the challenge. This policy certainty attracts progressive companies who believe they can profit from the coming green energy revolution and encourage the development of manufacturing and research facilities. Where progressive energy and environmental policies are implemented, so-called 'green-collar' jobs will follow.

Focus on renewable energy: Wind energy, emission reduction and job creation

The European Union's renewable energy policies are among the most progressive in the world, leading to both higher levels of investment and commensurately higher employment in the renewable energy sector. EU estimates indicate that there are currently 150,000 direct jobs in wind energy in the EU alone, half of the entire renewable energy industry. Germany, Denmark and Spain account for 70% of installed capacity and more than 90% of the EU's wind industry employees (see Figure 1)[7]. The European Wind Energy Association further states that over 60,000 jobs have been created in the last five years, an average of "33 new people every day, seven days a week". They go on and explain that "entire local communities have been revitalized as a consequence of wind turbine manufacturing and related activities," citing examples from Nakskov and Esbjerg in Denmark, Schleswig-Holstein in Germany and the region of Navarre in Spain, where the wind industry "continues to have a dramatic impact on the local economies and overall employment."[8]

Jobs stemming from investments in renewable energy don't just contribute towards the stabilization of an uncertain economy but towards the reduction of GHG emissions as well. On an annual basis:

- The European Wind Energy Association estimates that the 57GW of wind capacity installed in Europe at the end of 2007 avoids the emission of about 90 million tons of CO2[9];
- The Global Wind Energy Council adds that cumulative global wind power capacity could reach more than 1000 GW by the end of 2020, saving as much as 1.5 billion tons of CO2[10];
- Vestas Wind Systems monitors approximately 23,500 turbines on a real-time basis and estimates that they avoid over 40 million tons of CO2 emissions each year.

The Vestas V90 3.0-MW turbine alone is carbon neutral after only seven months of energy production; during its lifetime it saves the atmosphere from 220,000 tons of CO2.

Green Jobs: Three success stories in renewable energy

By encouraging renewable energy technologies in a sustained manner over the last twenty-five years, several countries have successfully built strong domestic industries and positioned themselves to capitalize on the rapid growth in global demand for renewable energy sources in the coming years.

Germany subsidized individual rooftop photovoltaic (PV) installation beginning in 1991 and has provided a 20-year "feed-in" tariff since 1990. To encourage adoption, from 1995-2004 the government provided loans for PV installation; the combined result of these policies has been to make Germany the top market for solar installations in the world.

During the 1973-74 OPEC crisis Japan and Denmark were 99% dependent on imported energy. Today, solar-powered electricity in Japan is cost-competitive with electricity produced from coal. The solar industry is now subsidy-free, and Japanese manufacturers currently represent 26% of the global solar PV market. Japan aims to have 30% of houses with solar panels by 2030 and has made great strides to achieve a more independent and secure energy supply.

Perhaps the most remarkable example is provided by Denmark. Since 1980, via policies promoting energy efficiency and renewable energy, Denmark's GDP has grown by 56% while its energy consumption remains unchanged. Wind energy now provides 20% of domestic electricity and Danish firms currently produce one-third of the world's wind.

The Danish government covered 30% of wind investment costs from 1979 to 1989, with loan guarantees later being provided for large turbine export projects. It also established utility purchase mandates at above market prices and funded research support for wind turbine design and manufacturing improvements. Moreover, financial incentives such as tax free income for wind generated by cooperatives has led to a high degree of citizen participation in the wind industry, with 80% of Denmark's turbines owned by over 150,000 Danish families.

The Danish wind industry is profiled in greater detail with a case study of wind energy giant Vestas

Denmark is a pioneer country in wind energy, having developed the industry over the course of the past several decades and currently boasting up to 20% wind energy in its electricity mix. Denmark is today home to some of the world's largest wind energy companies, including manufacturing, R&D and specialized service companies, and Danish manufacturers produce almost 40% of annual global installed capacity. [11] The Schleswig-Holstein government in northern Germany succeeded in creating an attractive environment for investment, including labor force and the necessary public infrastructure, to promote wind energy in the region. As a result, "each MW installed produces more than €100,000 of tax revenue during its 20 years of operation", and fiscal income from wind energy related activities was €5.8 million in 2004, with this amount expected to double in 2009. [12]

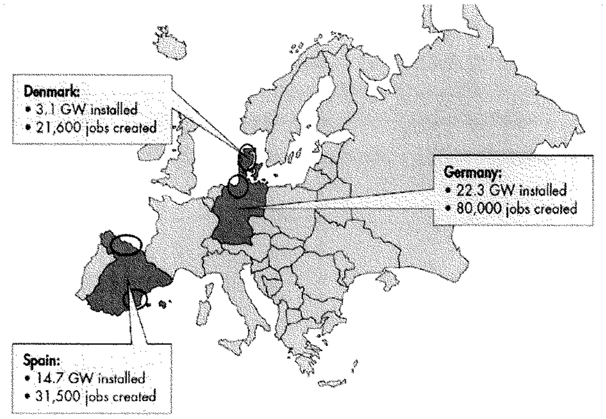

Figure 1. Map showing installed capacity of wind energy and jobs created in Germany, Spain and Denmark. Source: Boettcher et al.

The story is a similar one in Navarre, Spain: the region had strong support by the regional government to develop its wind industry base, and now boasts four wind turbine assembly factories, four blade factories, two component factories and one of the largest wind turbine testing laboratories in the world.[13]

The U.S. Department of Energy's recent report on 20% wind by 2030 in the U.S. estimates that almost 260,000 jobs will be generated per year to meet the 20% wind goal. That adds up to more than 6 million jobs from 2007 to 2030 only in the construction phase[14]. Operating 300GW of wind will require more than 76,000 direct jobs in 2030, with a total of more than 3 million jobs for operation from 2007-2030. The U.S. currently employs about 50,000 people in wind energy.[15]

In the United States, the Pacific Northwest region is one of the key clusters for the wind industry. The region expects that wind power can be a key sector for job growth and economic vitality for a number of reasons: a 75% target for clean electricity by 2025; the growing wind development community; policy incentives that have created an appropriate enabling environment; significant investment in infrastructure, and workforce development.[16]

The Renewable Northwest Project concludes the following about wind farms in Washington State: "wind power development in Washington represents a major economic windfall for the region. The four large, recently completed Washington wind farms are generating millions of dollars in new property tax revenue for counties, millions more in annual royalty payments for landowners and creating hundreds of new jobs."[17]

The consultancy McKinsey & Company has performed several studies on the wind industry that include evaluations of employment impact. In Wind, oil and Gas: the Potential of Wind, it concludes that the wind industry generates more jobs than the coal, gas and nuclear power industries per megawatt hour generated . Research institutions such as Berkeley's RAEL have reached similar conclusions. McKinsey continues and states that, for the U.S. to fulfill the 20% wind energy by 2030 target, many manufacturing jobs for the wind industry would be created and located in areas hardest hit with unemployment (see Figure 2)[18].

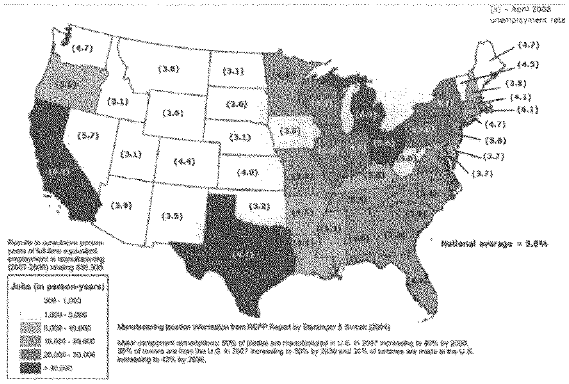

Figure 2. Potential manufacturing jobs needed to fulfill the 20% wind energy target by 2030 per state (colors on the map, the darker the color, the more jobs), compared to the U.S. rate of unemployment per state (numbers on each state). Source: McKinsey 2008

Rural clean energy and jobs: Solar in Kenya

Solar electrification has emerged as the primary alternative to grid-based rural electrification in a number of developing countries, including Kenya, one of the largest and most dynamic per capita adopters. Cumulative solar sales in Kenya since the mid-1980s are estimated to be in excess of 200,000 systems, and annual sales growth has regularly topped 15% over the past decade.[19] Much of this activity is related to the sale of household solar electric systems, which account for an estimated 75% of solar equipment sales in the country[20].

Kenya is served by a dynamic and highly competitive supply chain that includes more than a dozen import and manufacturing companies, and hundreds of vendors, installers, and after-sales service providers. Data from a survey in 2000 conducted by the Tegemeo Institute indicated that 4.2% of rural Kenyan households owned a solar system. The same survey found that 4.3% of rural households were connected to the national electrical grid, and numerous sources indicate that solar sales are growing faster than the rate of new rural grid connections[21]. In other words, solar electricity has emerged in Kenya as a key alternative to grid-based rural electrification.

The Kenyan solar market is also notable because it developed with minimal direct government support and only very moderate inputs from international donor aid groups. Solar sales in Kenya have historically been (and continue to be) driven largely by unsubsidized over-the-counter cash purchases of household solar systems [22]. This makes Kenya an important example of a growing international trend towards market-based approaches to rural energy service delivery. This market approach has important implications for the social significance of solar electrification, as it means that the distribution of access to the technology is strongly influenced by purchasing power.

Job creation and job improvement have been a hallmark of the best aspects of the Kenyan solar industry, with business opportunities for virtually the entire supply chain. Solar energy systems, batteries, and even small wind turbines are increasingly available either directly from designers/developers, or from the array of solar companies that aggressively advertise on TV, in local newspapers, and by radio. In addition, the Kenyan industry has 'gone viral', with versions in other African nations and beyond.

Green jobs: Addressing the critiques

Studies about green jobs have proliferated in the past few years from a wide variety of sources (non-government organizations, advocacy groups, industry groups, academics etc.), with varying estimates of job creation benefits and methodologies. As a response, these studies have also produced several critiques of green jobs studies and their conclusions.

Critics of green job studies cite allegedly incomplete accounting for the costs of green job programs, namely the jobs that are lost or shifted by such programs, and whether large capital investments by the government would be better spent elsewhere in the private sector.[23] For example, requiring renewable energy sources that are more expensive than conventional sources and/or directing large government subsidies for their production, may drive up costs and cause job loss, or it may furthermore crowd out other business investment. According to one study from King Juan Carlos University in Madrid, the Spanish government has created jobs at the rate of $775,000 per job with subsidies, more than twice the estimated amount for job creation through private industry investment ($350,000 per job).

However, neither green job studies nor their critiques typically include avoided environmental costs or other potential benefits (less imported fossil fuel, reduced health care costs, etc.) that would favor green job programs. Longer-term costs are difficult to quantify with uncertainties in their magnitude, attribution and timing but have the prospect for catastrophic irremediable damages. Furthermore, in some cases, businesses may not be equipped or organized to invest in large-scale beneficial projects such as grid modernization where the government needs to play an active planning and investment role.

At the macroeconomic level, it has been argued that global warming is one of history's greatest market failures and that to preclude the prospect of severe economic and social consequences in the future a transition to a low carbon economy is urgently needed. Policies and programs to support this transition are one way of viewing the green jobs movement, and thus the key question is not whether or not to support "green jobs", but how best to do it – which policies have the greatest benefit to cost ratio, how long-term benefits should be balanced against short-term costs, how economic dislocations should be minimized, and how best to position government policies in dynamic and competitive global markets.

How many jobs can be created by the clean energy economy?

An increasing number of studies are finding that greater use of renewable energy systems and energy efficiency provides economic benefits through job creation while at the same time providing protection from political and economic risks associated with over-reliance on a limited suite of energy technologies and fuels. This paper builds upon the results of a study that reviewed the range of recent studies on job creation potential of the renewable energy industry.[24] A cross-technology assessment of the U.S electricity sector yields the following key conclusions:

(1) **The renewable energy sector generates more jobs per unit of energy delivered than the fossil fuel-based sector.** This is true for all technologies within the renewable energy sector (Table 2). A 20% national RPS in 2020 produces more than a million additional job-years than the case where there is no renewable generation and this 20% of generation is produced by coal and natural gas (see Appendix).

(2) **Many sectors can contribute to both very low CO2 emissions and significant job creation.** Each of the following different scenarios can produce half a million job-years by 2020: (a) reducing energy growth by fifty percent over reference levels through greater energy efficiency (0.5% per year annual growth vs. 1% reference); or (b) increasing RPS to 25% from the reference case of 7%; or (c) increasing nuclear power generation capacity to 30% of overall generation from the reference baseline of about 20% (see Appendix).

(3) **Among the common RPS technologies, solar PV creates the most jobs per unit of electricity output.** For a 20% RPS target in 2020, doubling the amount of solar PV from 1% to 2% of overall generation increases the number of jobs from 399,000 to 732,000 job-years (see Appendix).

(4) **By targeting national RPS and electricity growth rates, as well as increasing low carbon sources, the job creation potential is in the millions.** A national RPS of 25% in 2025 coupled with 0.5% annual electricity growth rate (vs. 1% reference) can generate over two million jobs, and further increasing low carbon sources by about 50%

generates over three million jobs. This additive approach results in 90% of electricity supply from renewable or low carbon sources.

(5) Carbon capture and storage does not yet appear to be a significant driver for expanding net employment. CCS has a lower job multiplier compared to the average multiplier for renewable technologies (Table 2). Currently CCS has a lack of viable demonstration plants and large uncertainties in commercial viability, technology, and regulatory environment. Unless there are major national initiatives and expansion coupled with rapid technological progress, we do not expect a high penetration rate of the technology by 2020 and hence project relatively smaller employment impacts

Study results

Technology	Total Job-Years per GWh
Biomass	0.22
Geothermal	0.25
Solar PV	0.91
Solar Thermal	0.27
Wind	0.17
Carbon Capture & Storage	0.18
Nuclear	0.15
Coal	0.11
Natural Gas	0.11
Energy Efficency	0.38

Table 2: Average employment for different energy technologies normalized to the amount of energy produced (or saved in the case of energy efficiency). All renewable energy sources produce more jobs than coal and natural gas.

Jobs in the wind industry: The Vestas example

Vestas is the largest pure-play wind turbine manufacturer on the market: a global company with local expertise, represented in 24 countries and with multiple production facilities in Denmark, Norway, Sweden, Germany, China, India, Italy, Spain, England, and the USA. Vestas has installed more than 38000 turbines in 62 countries and on 5 continents. Vestas installs a new turbine on average every 3 hours somewhere on the planet. Vestas also has the largest R&D facility in the industry that employs more than 500 top engineers from around the world.

In the last five years, Vestas' revenue has more than quadrupled (from 1400 m€ in 2002 to 6035 m€ in 2008), and Vestas has more than doubled the yearly amount of MWs installed (from 2670 MW in 2002 to 5,580MW in 2007). To keep up with this rapid growth Vestas has continuously been ramping up its human resources: Vestas currently employs around 21,000 people representing 56 different nationalities.

Illustrative case: Vestas in the U.S.

Vestas Americas is the business unit that covers the U.S. and Canadian markets. Vestas Americas has been present in the U.S. since the wind boom of the 1980s, and is currently based in Portland, Oregon. Vestas Americas has a cumulative installed capacity of almost 6500MW, and it installed 1630MW in 2008. (see Appendix)

In addition to the headquarters in Portland, Vestas operates a number of facilities in the U.S. Vestas currently employs over 1700 in the U.S., and expects to directly employ 4000 people in the U.S. by the end of 2010. The employment forecasts can be seen by facility in Table 3.

The approximately 7000-8000 components of the nacelles at the new assembly line will be sourced by the already functioning purchasing office in Chicago, creating great job growth for possible sub-suppliers in the U.S.

Table 3. New Vestas facilities in the U.S., with opening dates and expected employment.

New facility	Start date	Employees
Blade factory in Windsor, CO	2008	650 by mid-2009
Blade factory in Brighton, CO	2010	650 by mid-2010
Tower factory in Pueblo, CO	2009	500 by mid-2010
Nacelle assembly in Brighton, CO	2010	700 by 2010
Total, new facilities		2500
Total, with current facilities		4000

Energy efficiency: An investment in economic growth

In the current global economic situation, where governments are scrambling to avoid economic and technological stagnation, it is easy to see how investment in energy efficiency may play a vital role in the return to normal, business-as-usual conditions. In the 2009 US Stimulus bill, 5% of the $787 billion allocation was targeted to the renewable energy industry; the two largest portions of that $41.4 billion were put into energy efficiency and smart grid technology. The investment in energy efficiency, especially, has immense positive and immediate economic implications.

According to the Apollo Alliance's research it is projected that about 13 FTE jobs are created per million dollars invested into EE from direct installation and production of relevant materials alone. Arguably, if efforts are made in expanding the range of energy efficiency improvements then there may be greater job creation potential as well as more energy savings for the property owner. Beyond job creation potential, construction spending on EE is projected to pay for itself over time. The California Sustainable Building Task Force estimated that for an initial investment of $100,000 for energy efficiency in a $5 million construction project, there would be savings of $1 million over the life of the building.

The most remarkable implications lie in Dr. David Roland-Holst's 2008 study of job creation in California, which suggests that increase in disposable income due to the energy savings for a household can be responsible for the creation of many jobs. These findings show that about 1.5 million induced FTE jobs with a total payroll of $45 billion were created due to the energy efficiency savings of $56 billion in the 34-year period from 1972-2006.

Smart grids: Adding jobs and cutting energy usage

The Smart Grid, a term for a modernized transmission and distribution infrastructure for electricity, is intended to transform the electricity service sector by allowing electricity consumers and producers to communicate pricing, supply, and demand information in real time and thus purchase, sell and use power more efficiently.

A smart grid is another promising vehicle for job growth and could create many permanent new jobs not only from direct utility jobs but from enhanced investment in infrastructure equipment manufacturing as well. The in-home devices that are needed to broker between power suppliers and consumers are another potential new market for manufacturers. Much like energy efficiency, Smart Grid technology would be a long term investment in the efficient use of power and reducing overall energy usage, and could generate considerable job growth in the process.

Final remarks

Renewable energy and energy efficiency investment can be strong drivers for economic development and employment while insulating the economy from the volatility that stems from overreliance on only a few energy technologies. Studies suggest that countries and companies that take strong early action towards improving their energy use stand to benefit the most, notably due to the increasing certainty of a market price on carbon and tightening of emission limits over time.

However, to ensure the best chance for success, government policy needs to have continuity, predictability and reliability in encouraging cleaner sources of energy as well as conservation and energy efficiency. Scaled investment in renewable energy requires a long term commitment to production targets as well as sustained research support, transmission infrastructure investment, and streamlined planning and permitting procedures; energy efficiency requires aggressive policies of building codes and equipment standards, which can further spur innovation. These investments do not materialize overnight and require long-term policy certainty to be fully realized. Wind-turbine manufacturer Vestas is an excellent example of a company that has benefitted from the reliability and consistency of European renewable energy policy, with a four-fold increase in revenues since 2002 and major expansion plans in the United States.

The jobs study undertaken by UC Berkeley provides a clear indication that the renewable energy sector generates more jobs per unit of energy delivered than the fossil fuel sector. A portfolio of technologies and policies are needed to reach GHG reduction goals in a timely and cost effective manner: energy efficiency, renewable energy mandates (such as a Renewable Portfolio Standard), and nuclear power all have an important role to play in reducing CO2 emissions while generating large numbers of jobs at the same time.

The quantitative analysis that has been undertaken to date is not without its weaknesses. Current studies stem largely from developed nations and are focused on wind, solar, and energy efficiency. More study is needed on emerging technologies such as ocean energy and CCS as well as a modernized electricity grid and storage. More study is also needed in developing nations where renewable energy may play a large role in economic development and traditional power systems may be less deployed.

That said, there is mounting evidence that our climate is perched at a tipping point and that it is only through strong investment on a massive scale in renewable energy systems that there is a chance of avoiding the more dangerous predictions suggested by climate models. Politicians and industry leaders must set a resolute example by committing to long-term low-carbon solutions that will at once place the economy back on track while decoupling economic growth from emissions growth once and for all.

Glossary of terms

BAU: Business-as-usual trend without any further policy or interventions. In this paper, it refers to projections of electricity generation and sources of electricity supply to 2030 in the United States by the Energy Information Agency of the United States Department of Energy.

Feed-in Tariff: an incentive structure to promote greater production of renewable power whereby regional or national electricity utilities are obligated to buy renewable electricity (solar photovoltaics, wind power, biomass, hydropower and geothermal power) at above-market rates set by the government.

Job-Year (or "FTE"): One FTE (full-time equivalent) job is equivalent to one job-year, meaning a person employed full-time for one year. Note then that "50 FTE jobs" could mean either five full time jobs over 10 years or 25 jobs over two years or other such combinations.

RPS: Renewable Portfolio Standards are renewable energy mandates in the United States requiring that a certain percentage of overall electric power be sourced from renewable sources in advance of certain specified dates.

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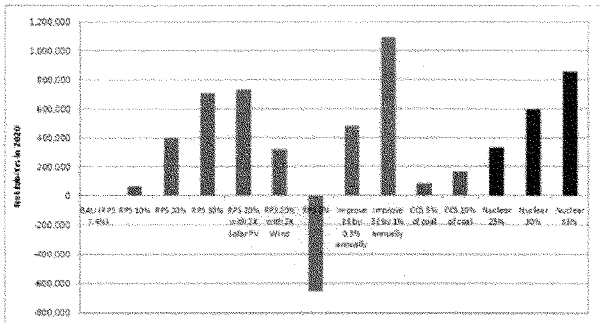
Appendix



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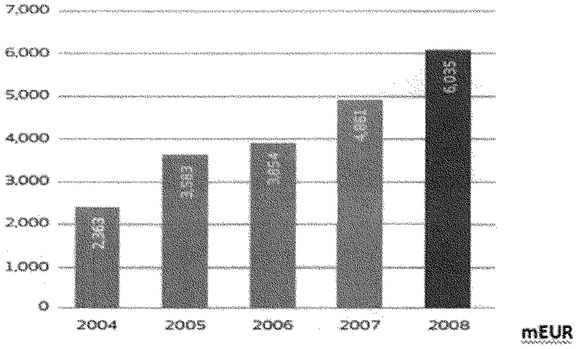

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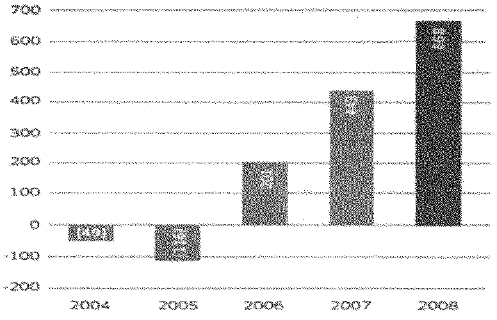
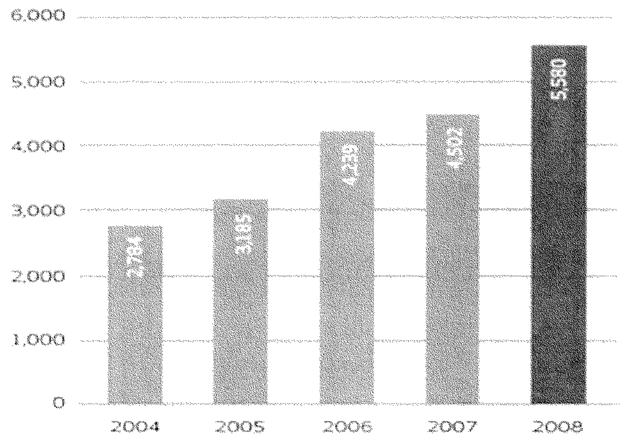
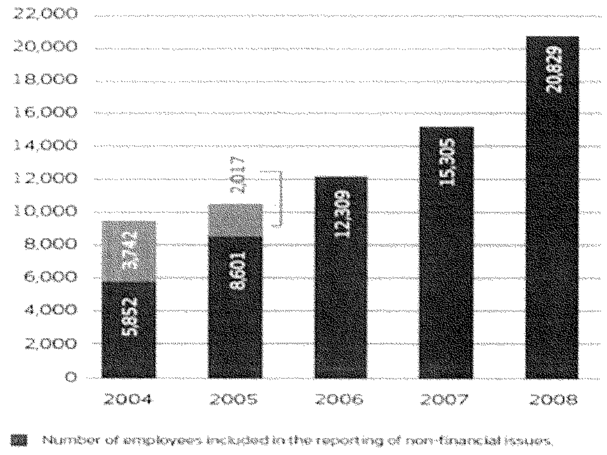


MW delivered



Employees



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Copenhagen Climate Council Secretariat

Monday Morning
Valkendorfsgade 13, P.O. Box 1127
DK-1009 Copenhagen K
Phone: +45 3393 9323
Telefax: +45 3314 1394
Mail: ccc@copenhagenclimatecouncil.com
www.copenhagenclimatecouncil.com

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GUIDE TO

ENERGY EFFICIENCY & RENEWABLE ENERGY FINANCING DISTRICTS

FOR LOCAL GOVERNMENTS

SEPTEMBER 2009

PREPARED BY
RENEWABLE AND APPROPRIATE ENERGY LABORATORY (RAEL)
UNIVERSITY OF CALIFORNIA, BERKELEY
MERRIAN C. FULLER | CATHY KUNKEL | DANIEL M. KAMMEN
FOR THE CITY OF BERKELEY, CALIFORNIA

CITY OF BERKELEY

Renewable
and Appropriate
Energy Laboratory
UC Berkeley

University of
California
Berkeley

RAEL was founded in 2000 by Daniel M. Kammen as an interdisciplinary research and implementation center focused on low carbon energy solutions. Inquiries can be directed to Professor Daniel Kammen at 510.642.1640, and at http://rael.berkeley.edu

Contents

Executive Summary

1. Introduction to Energy Financing Districts 5

2. Getting Started 10

3. Financing Elements 12

4. Case Studies 16
    Berkeley, California 16
    Palm Desert, California 16
    Boulder County, Colorado 17
    Babylon, New York 18
    Case Study Comparison Chart 19

5. Identifying the Demand in Your Community 20

6. Legal Authority 22

7. The Financing Mechanism 26

8. Administration & Program Costs 31

9. Defining Eligible Projects & Getting Results 36

10. Education & Outreach 38

11. Conclusion 40

12. Resources 41

Appendix 44

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Acronyms

Berkeley FIRST	Berkeley Financing Initiative for Renewable and Sustainable Technology
BPI	Building Performance Institute
CEAD	Clean Energy Assessment District (ie PACE or Energy Assessment Districts)
PACE	Property-Assessed Clean Energy (ie CEAD or Energy Assessment Districts)
DEER	Database for Energy Efficient Resources
DSIRE	Database of State Incentives for Renewables & Efficiency
EECBG	Energy Efficiency and Conservation Block Grants
EIM	Energy Improvement Mortgage
EIP	Energy Independence Program, City of Palm Desert
FICO	Fair Isaac Corporation (a credit rating agency)
GHG	Greenhouse Gas
HPwES	Home Performance with Energy Star
ICLEI	Local Governments for Sustainability
LEED	Leadership in Energy and Environmental Design
OBF	On-Bill Financing
OEM	Office of Energy Management
PAYS®	Pay As You Save
PV	Photovoltaic
RIC	Retail Installment Contract
TIP	Tariffed Installation Program

Executive Summary

Improving energy efficiency in buildings is central to combating climate change, with more than a third of U.S. greenhouse gas emissions coming from the building sector. Over the past year, there has been a much stronger push from the federal level to fund energy efficiency programs as part of a national agenda to foster a clean energy economy that generates sustainable high-quality jobs and reduces our dependence on imported fossil fuels. Vital to this process is to develop innovative financing solutions that reach broadly across energy efficiency and low-carbon energy options.

Energy Financing Districts (a.k.a Property-Assessed Clean Energy (PACE), Sustainable Energy Financing, Clean Energy Assessment Districts (CEAD), Contractual Assessments, or Special Tax Districts) were first proposed by the City of Berkeley, California in 2007 and have received increasing attention as a mechanism for financing residential or commercial clean energy projects, including energy efficiency, solar photovoltaic, or solar thermal systems. EFD's represent one specific and powerful example of an intellectual innovation that is broadly applicable to fostering a profitable transition to a clean energy economy at the local, regional, national, and global levels.

WHAT IS AN ENERGY FINANCING DISTRICT?

Energy Financing Districts (EFDs) enable local governments to raise money through the issuance of bonds to fund these clean energy projects (though bonds are not the only possible source of funds). The financing is repaid over a set number of years through a "special tax" or "assessment" on the property tax bill of only those property owners who choose to participate in the program. The financing is secured with a lien on the property, and, like other taxes, is paid before other claims against the property in the case of foreclosure. There is little or no up-front cost to the property owner, and if the property is sold before the end of the repayment period, the new owner inherits both the repayment obligation and the financed improvements.

Establishing an EFD requires the following steps:

1. Determine authority for EFDs; pursue enabling legislation if needed
2. Identify lead staff and advisors
3. Design the program to meet specified goals, with input from stakeholders
4. Secure funding
5. Formally create the special tax district or tax assessment district
6. Launch Program

BENEFITS OF ENERGY FINANCING DISTRICTS

Energy Financing Districts offer many advantages to homeowners, including a long repayment period, potentially lower interest rate, tax-deductible interest payments, and an easier application process than applying for a second mortgage or home equity line. Unlike most other financing options, the repayment obligation transfers when the property is sold, allowing homeowners to invest in improvements that will pay back over a longer timeframe than the owner intends to remain in the house.

For local governments, an EFD provides an opportunity to address climate change locally, to support residents' environmentally-friendly building improvements at low cost to government, and to strengthen the local economy in energy efficiency retrofitting and solar installation. Because the loans are secured by property liens, an EFD program provides virtually no risk to the local government's general fund.

HOW TO USE THIS REPORT

This report is designed for local government officials, local government decision-makers, state policymakers, and civil society groups interested in getting an EFD program established in their region. Policymakers interested in understanding what EFD is and its advantages and disadvantages relative to other residential energy financing schemes should focus on the Introduction and Section 3 (Financing Elements). Advocates of establishing an EFD program may wish to focus on Section 4 (Case Studies) to understand how this program has been successful in other locations. Local officials working to implement an EFD program should refer to Section 2 (Getting Started) and Sections 5-10 for an understanding of the process of setting up an EFD program, including administrative, legal, and financial issues. And state-level policymakers may wish to refer to Section 6 (Legal Authority) for suggestions on how statewide enabling legislation could facilitate the establishment of EFD programs locally.

1. Introduction to Energy Financing Districts

Energy Efficiency and Renewable Energy Financing Districts help local government leaders advance their goals of reducing greenhouse gas (GHG) emissions in their communities, furthering energy independence, and stimulating the local economy. This guide is designed to aid local government leaders in establishing Energy Financing Districts with the benefit of the experience from trailblazing communities such as Berkeley and Palm Desert in California; Boulder County, Colorado; and Babylon, New York.

LOCAL GOVERNMENT ACTION

There is a growing awareness that responding to climate change and reducing our dependence on fossil fuels will require actions on all levels - federal, state, municipal, and personal. In many ways, local governments have stepped up as first responders to the climate crisis. Cities and counties have committed to concrete greenhouse gas emission reduction targets, such as the over 900 mayors who signed the U.S. Conference of Mayors Climate Protection Agreement.[1] Municipalities have modernized their building codes to encourage energy efficiency and solar energy, launched public education campaigns, and pursued "greening" their own facilities and procurement supply chains on their own or with the help of groups like ICLEI (Local Governments for Sustainability).[2]

An important arena for the transformation to a more resource-efficient economy is the building sector, which accounts for 72% of electricity use[3] and over 36% of greenhouse gas emissions[4] in the U.S. Improving the resource use of our new and existing buildings is extremely important both to improve the comfort and affordability of homes, and to address climate change and the pollution created by the consumption of conventional energy.

Buildings have many-decade lifetimes, and today's buildings will continue to be a majority of all buildings in 2050. Without a focused effort to reduce energy demand in existing buildings, it will be virtually impossible to meet even the most modest greenhouse gas reduction targets. Reducing energy demand in buildings includes sealing leaks in walls, floors, attics, ducts and windows; upgrading lighting; installing more efficient heating and cooling systems, and other improvements. In addition, we can generate renewable energy onsite with solar thermal and solar electric systems, which reduce demand on our existing energy supplies and avoid emitting GHGs and other pollutants.

BARRIERS TO ACTION

Despite the potential for reducing energy consumption in buildings, a wide range of barriers limit investment in building energy efficiency and solar energy. There are several important economic barriers to improving the resource use of buildings that are important to note for this discussion, including:

Lack of information
Many customers do not know how to implement energy efficiency or solar energy, and may not understand the benefits of a project.

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[1] Website: http://www.usmayors.org/climateprotection
[2] Website: http://www.iclei.org
[3] Buildings Energy Data Book September 2007: 1.1 Buildings Sector Energy Consumption.
[4] EIA 2006: Emissions of Greenhouse Gases in the United States.

Uncertainty of savings
Homeowners and businesses may not trust that the improvements will save them money or have the other benefits claimed.

Split incentives
Split incentives occur when the decision-maker does not receive many of the benefits of the improvements. An example is the case of rental property owners who lack incentives to invest in building efficiency upgrades when the tenant pays the utility bill.

Transaction costs
The time and effort required to get enough information to make a decision, apply for financing, and arrange for the work to be done may simply not be perceived as worth the return in energy savings and other benefits.

Initial capital investment
The first cost of a project may deter investment, either because the resident or business owner does not have access to capital or they choose to make other higher-priority investments.

Length of paybacks
Homeowners and business owners may not want to invest in comprehensive retrofits if they do not plan to stay in the building long enough to recoup their investment.

Federal, state, and local governments have established a range of programs (e.g. ENERGY STAR, building codes, tax credits) to address some of the barriers to adoption of energy efficiency and renewable energy technologies. As a complement to existing programs, a few local governments have experimented with a new approach - Energy Financing Districts - that primarily address the last two barriers.

HOW ENERGY FINANCING DISTRICTS WORK

Energy Financing Districts (a.k.a Property-Assessed Clean Energy (PACE), Sustainable Energy Financing, Clean Energy Assessment Districts (CEAD), Contractual Assessments, or Special Tax Districts) are one way for a city or county to provide access to capital for their residents' and businesses' clean energy projects, including energy efficiency retrofits and installation of renewables such as solar thermal or solar electric systems. Energy Financing Districts tap into existing mechanisms that local governments are already familiar with, such as special tax districts or assessment districts, and allow these mechanisms to support clean energy projects. Energy Financing Districts enable local governments to raise money through the issuance of bonds to fund these clean energy projects (though bonds are not the only possible source of funds). The financing is repaid over a set number of years through a "special tax" or "assessment" on the property tax bill of only those property owners who choose to participate in the program. The financing is secured with a lien on the property, and, like other taxes, is paid before other claims against the property in the case of foreclosure. There is little or no up-front cost to the property owner, and if the property is sold before the end of the repayment period, the new owner inherits both the repayment obligation and the financed improvements.

Energy Financing Districts have been set up to fund both renewable energy (solar PV and solar thermal) and energy efficiency. From a financing perspective, there is no difference between funding these improvements. However, local governments should be aware that financing an energy efficiency program can require more effort to decide which measures are eligible and how to ensure installations are completed. Solar PV and solar thermal financing programs are often simpler because there is just one basic technology involved, especially in states like California where there are solar rebate programs that have quality assurance systems that are easy to tap into.[5] However, it is important to note that installing solar without also making efficiency improvements is not advisable. Efficiency measures usually have a faster payback than solar, and if efficiency is done after a solar installation, the solar PV or solar thermal system may turn out to be oversized once demand is reduced through efficiency improvements.

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[5] See the California Solar Initiative: http://www.gosolarcalifornia.org

BENEFITS OF ENERGY FINANCING DISTRICTS

There are over 150-energy efficiency financing programs in the U.S., often run by utility companies, in addition to the many traditional loan products offered by financial institutions. Limitations of these financing programs often include short repayment periods, high interest rates, stringent credit requirements that do not account for energy savings, lack of options for recent homebuyers who have not built up equity, and limited availability for households most in need, to name a few.[6] Energy Financing Districts have several advantages for participants over other financing options, such as:

Longer repayment period
Energy Financing Districts offer a longer term of up to 20 years, compared to the standard 5 to 7 years of many utilities programs and conventional loans, thus allowing participants to do more comprehensive work and more closely match their payments with the energy savings.

Repayment transfers with ownership
Many property owners do not want to invest in energy efficiency or solar energy improvements if they plan to sell their property in a few years. Energy Financing Districts allow the current owner to invest today, knowing that the repayments and the financed improvements will transfer to the new owner if he or she decides to sell the property.

Information from a trusted source
Trust is a key issue in encouraging residents to act. People are getting information from an overwhelming number of sources. Local governments are an objective source of information, providing tools and resources to enable residents and businesses to take action. For example, local governments can offer a single source of information on how to get started with clean energy upgrades, and many local governments provide educational workshops about the options available to their constituents.

Low interest rates
Low rates may be available due to the lower interest on municipal bonds and other sources of financing available to local governments, although administrative fees may push the cost of an Energy Financing District program up above conventional options such as a home equity loan or second mortgage.

Tax benefits
The interest portion of the repayments are tax deductible, similar to a mortgage. Homeowners are also eligible for the federal income tax credit (FITC), a 30% investment tax credit for residential and commercial solar installations

Reduced transaction costs
Energy Financing Districts often offer an easier process than applying for a home equity line or second mortgage. They are specifically designed to finance clean energy improvements so the steps to adoption are clearly spelled out in program guidelines, avoiding the need for property owners to arrange for financing on their own.

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[6] Further analysis and specific case studies of existing financing programs can be found in "Enabling Investments in Energy Efficiency: A study of energy efficiency programs that reduce first-cost barriers in the residential sector" (Fuller 2008), available online: http://ciee.ucop.edu/energyeff/documents/CA_ResiFinancing.pdf

From the point of view of local governments, Energy Financing Districts offer the following advantages:

Direct support for constituents' actions
Energy Financing Districts are a way for local governments to support climate and environment-friendly building improvements with very little direct cost to government.

Job creation
This new economic activity stimulates the local economy and creates new jobs as the solar energy and energy efficiency sectors grow.

Positive publicity
The local governments that have been involved with Energy Financing Districts thus far have received positive attention from the media and local civic groups.

Safe and efficient security mechanism
This financing mechanism is extremely secure due to the priority lien on the property, and delinquent special taxes and assessments are repaid before private liens in the case of foreclosure; risk to the local government's general fund is minimal.

LIMITATIONS OF ENERGY FINANCING DISTRICTS

These advantages make Energy Financing Districts an attractive option for property owners, but there are certain limitations local governments should recognize. First, this program is available only to property owners; renters cannot access this program directly. The main issue is split incentives – the owner would need to invest in the improvements but tenants generally pay the utility bills. In some cities a significant percentage of the residents and commercial businesses are renters. Residential renters also tend to disproportionally have low or moderate incomes, meaning that those most in need often will not be able to access this program. Local governments may need other targeted policies and incentives for rental properties in addition to the existing low-income weatherization programs. However, it is possible that the advantages of this mechanism may still attract rental property owners who see the value of investing in their property in order to capture higher rents (subject to rent control laws) and better retention of tenants; it is too early to tell how rental property owners will respond.

Another limitation is that the expected life of the installed improvements must be at least as long as the repayment period and be attached to the property. Thus, when a property changes hands, the new owner will continue receiving energy generation or savings. The program cannot finance portable items such as efficient light bulbs and refrigerators because they can be easily removed when the current owner leaves. Local governments must find other ways to encourage these valuable upgrades.

A final limitation is that setting up and administering an Energy Financing District requires staff time on the part of local governments. Local governments with existing Energy Financing Districts have dedicated staff with the time and motivation to pursue new ideas in this arena, combined with support from their local mayors, council members, and other government officials. Now that there are several working models, replicating the program will be easier. There are also opportunities to pool resources to create countywide or regional programs; Boulder County is an example of this. Still, the concerted effort needed to pass state-wide enabling legislation where it is lacking, get local approval, as well as design and administer the program should not be underestimated.

Additionally, Berkeley has found that the pilot program has some built in limitations stemming from the limited time period for its operation and its relatively small scale. Due to its small scale and being new conceptually, access to financing was limited, particularly in the current economic environment. Thus, the financing Berkeley obtained was made available for a limited time period of 270 days so that all projects had to be completed within that time period; and the interest rate is higher than some other sources of funding, such as home equity loans. Therefore, as some owners who made reservations later dropped out, it was not possible to add new participants from others who had expressed an interest.

WHAT THIS GUIDE INCLUDES

The next section walks through the basic steps to getting a program up and running. Section 3 provides background information on how financing works and the elements that should be considered in any financing program. We then present case studies in Section 4 of four communities that have launched variations of Energy Financing Districts - Berkeley, California; Palm Desert, California; Boulder County, Colorado; and Babylon, New York. This guide draws most heavily upon the experience of Berkeley, but lessons from the three other communities are included throughout the guide. Section 5 describes how Berkeley assessed the need for this program and solicited feedback from stakeholders. Section 6 describes the legal process for enabling Energy Financing Districts, including some general guidance on pursuing enabling legislation in other states. Section 7 describes how the Berkeley program's financing is structured, and provides guidance on how to set up funding for the program. Section 8 describes the administrative requirements of the program, including some estimates of program costs based on experience to date. Section 9 describes how existing programs have defined eligible clean energy projects. Section 10 provides ideas for promotion and outreach. We include a final section with resource documents from existing programs and other useful information; such as sample Request for Proposals, financing agreements, council resolutions, etc - with the links to the full documents online available here: http://rael.berkeley.edu/financing/resources and described in recent journal publications.[7]

HOW TO USE THIS REPORT

This report is designed for local government officials, local government decision makers, state policymakers, and civil society groups interested in getting an EFD program established in their region. Policymakers interested in understanding what EFD is and its advantages and disadvantages relative to other residential energy financing schemes should focus on this Introduction and Section 3 (Introduction to Financing). Advocates of establishing an EFD program may wish to focus on Section 4 (Case Studies) to understand how this program has been successful in other locations. Local officials working to implement an EFD program should refer to Sections 5-10 for an understanding of the process of setting up an EFD program, including administrative, legal, and financial issues. And state-level policymakers may wish to refer to Section 6 (Legal Authority) for suggestions on how statewide enabling legislation could facilitate the establishment of EFD programs locally.

We hope this information will help get you started!

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[7] Fuller, M, Portis, S. and Kammen, D. M. (2009) "Towards a low-carbon economy: municipal financing for energy efficiency and solar power", Environment, 51 (1), 22 - 32.

2. Getting Started

We estimate that the process for developing an Energy Financing District to the point of launch should take 6 to 12 months once there is enabling legislation, depending on approval schedules and the amount of resources a local government is able to direct towards this effort. Drawn from the experience of existing programs, these are the steps to create a program:

→ DETERMINE AUTHORITY FOR ENERGY FINANCING DISTRICTS; PURSUE ENABLING LEGISLATION IF NEEDED

Most communities will require authorization from the state legislature to allow local governments to collect a special tax or assessment to pay for energy efficiency or renewable energy improvements on private property. In California, local governments already have this authority under Chapter 29 of the 1911 Assessment Act through AB 811 and through Mello-Roos (for charter cities currently and, for other local agencies if pending amendments are signed into law). Colorado, Louisiana, Maryland, Nevada, New Mexico, Ohio, Oklahoma, Oregon, Texas, Vermont, Virginia, and Wisconsin also have existing legislation providing local authority, with several more states soon to follow. The Database of State Incentives for Renewables and Efficiency (DSIRE) created a new policy category called "Property Tax Financing Authorization" for this type of financing, and information on these state laws and any new ones that are adopted can be found at http://www.dsireusa.org. We provide guidance and additional resources for enabling legislation in Section 6 on page 22.

→ IDENTIFY KEY STAFF AND ADVISORS

The local government should evaluate whether capacity exists in-house to manage this program or whether it will need to engage financial or administrative partners. Partnerships can range from a turnkey administrative and financial partner that handles all the processing and bond purchasing to the targeted use of outside expertise. Important team members for planning and implementation include:

- Senior Managers and analysts from the City Manager's office, the County Administrator's office, and the department that will be administering the program
- Legal counsel representing the jurisdiction and/or Bond Counsel
- Finance/Auditor-Controller Department representative and/or a financial consultant
- Climate, energy, or sustainability program staff person (if available)
- Staff from energy efficiency and renewable energy programs operated by government, utility, or local nonprofit
- Staff from the County Recorder and/or Tax Collectors offices

Guidance on the administrative requirements and programs costs can be found in Section 8 on page 31.

→ DESIGN THE PROGRAM TO MEET SPECIFIED GOALS, WITH INPUT FROM STAKEHOLDERS

The planning for this program should integrate the local government's greenhouse gas reduction targets or economic development and workforce development goals. To ensure success, it is important to engage local stakeholders and potential partners to assist in determining program goals, key program design elements, and criteria for eligible improvements. Guidance on program planning is available in Section 5 on page 20, and suggestions for defining eligible projects are in Section 9 on page 36. We also provide program design and planning documents from existing programs in Section 12 on page 41.

➔ SECURE FUNDING

The ability to fund these types of districts is perhaps the biggest hurdle for many local agencies. Local governments with large reserves may benefit from the financing as one of their investment portfolio strategies. The ability to attract major lenders to this type of program is just now being tested in the market. There are several efforts in California and Colorado to line up financing that will provide an investment with low risk and an interest rate that results in long-term savings for program participants. The design of the Berkeley FIRST program relies on investment entirely from a financial firm working with a commercial line of credit from a local bank. The firm purchases the City's bonds through an agreement with the City. Alternatively, Palm Desert and Sonoma County are utilizing unallocated reserves to issue loans. One possible source of funds are Energy Efficiency and Conservation Block Grants (EECBG), a portion of which can be used to support the creation of Energy Financing Districts. For more details on securing funding, see Section 7 on page 26.

➔ FORMALLY CREATE THE SPECIAL TAX DISTRICT OR TAX ASSESSMENT DISTRICT

This step is likely to require several actions by the City Council or County Board of Supervisors for various approvals. There are two ways to do this in California, through *assessments* (contractual assessments under amendments to the 1911 Improvement Act made by Assembly Bill 811) and through *special taxes* (currently available only to charter cities, although an amendment to the Mello-Roos Community Facilities Act of 1982 is pending). These processes are described in Section 6 on page 22. Processes for the creation of the financing district will vary from state to state, and county to county.

➔ LAUNCH PROGRAM

Once the legislative actions are completed, program marketing and outreach should focus on education about both the energy benefits such as saving money and reducing greenhouse gas emissions, and also the non-energy benefits such as improving occupants' health and improving home and office comfort that result from energy efficiency and renewable energy improvements. Residents should be advised on the expected costs and savings if they install efficiency measures or renewable energy under the program. The program should be rolled out with as much detail as possible about the cost of financing and availability of funds. Local governments should be careful not to set up expectations for the public too early, especially since anticipation of a program may delay some consumers from making improvements. For more details on promotion and outreach, see Section 10 on page 38.

3. Financing Elements

The purpose of this section is to familiarize local government leaders with the common elements of financing products. The table below offers a chart with the program elements organized by categories discussed in this section with the most common elements of Energy Financing Districts highlighted.

FINANCING PROGRAM ELEMENTS

SOURCES OF CAPITAL	FINANCING MECHANISM	COLLECTION MECHANISM	ENHANCEMENTS	ELIGIBLE MEASURES	UNDERWRITING CRITERIA	SECURITY INTERESTS
Banks	Personal loan (secured or unsecured)	Amortized payment bill	Reduced interest rates	Energy efficiency	Debt to income ratio	Unsecured
Public benefit charge or added to rate base	Mortgage / home equity (secured to real estate)	Lease payment	Stretched underwriting criteria	Renewables	FICO score	UCC fixture filing
Utility general funds	Line of credit (secured or unsecured)	On utility bill	Guarantees	Other home improvements	Utility bill payment history	Mechanics lien
Federal, state or local govt funds	Lease	On property tax bill	Loan loss or late payment reserves		Tax payment history	Other lien on real estate
Municipal bonds	Retail installment contract	Performance contract bills	Rebates		Other	Lien on other property (car, boat, etc)
Manufacturers	Special tax or assessment levied	Buy kWh or therms	Tax credits			Disconnection for non-payment
Pension funds	Tariffed installation program		Subsidized transaction costs			
Housing or economic dev finance agency	Performance contract		Aggregation			
Qualified energy conservation bonds	Power purchase agreement		Environmental or carbon credits			
Other 3rd party						

SOURCES OF CAPITAL

There are many possible sources of capital for a financing program. For most existing energy efficiency financing programs, capital has been provided by banks or utility general funds, and is often supplemented by utility-collected funds from a public benefit charge or an addition to the rate base to provide lower than market rates of interest. Other sources include manufacturers who help finance their own equipment, leasing companies, municipal bonds, state treasuries and pension funds, and housing and economic development agencies. Energy Financing Districts generally issue municipal bonds, although Palm Desert started its program with the city's general revenue funds and Babylon uses its municipal solid waste fund as a revolving pool of capital.

FINANCING MECHANISMS

An Energy Financing District uses a special tax or assessment levied through the property tax bill. There are several other options for financing energy improvements. Some of the financing mechanisms are fairly standard – a direct consumer loan can be unsecured or secured to an asset such as a car or the improvement itself; a mortgage or home equity loan is secured by the property; and a secured or unsecured line of credit allows the borrower to draw down funds as needed instead of as a lump sum. A retail installment contract (RIC), used by a few existing efficiency financing programs, is one type of unsecured consumer loan that is often used to purchase new cars.[8]

These more traditional options may offer rates lower than those offered by Energy Financing Districts. For example, mortgage and home equity loan rates are currently 4% to 7%. However, the lower rates are available only to those with higher credit scores, and, unlike Energy Financing Districts, these forms of debt would have to be paid off by the borrower even if the property (and the improvement) were transferred to a new owner.

There are also variations on a traditional mortgage product that are relevant to energy improvements. An Energy Improvement Mortgage (EIM)[9] allows a new home buyer to get additional financing rolled into the first mortgage to cover the cost of energy improvements. Vermont Energy Investment Corporation (VEIC) conducted a pilot of this mechanism more than a decade ago, but it has rarely been used, largely due to the already-challenging process of closing a home; the hassle of figuring out the EIM on top of the initial mortgage is usually prohibitive[10] – though EIMs may become useful if combined with public policy that encourages improvements at the time-of-sale. New programs have recently been launched in Colorado, Maine, and New York.

Another option is a tariffed installation program (TIP), which uses a utility's billing system to collect a charge that has been attached to the meter as a special tariff. A local government could do this through their municipal utility or water district. TIPs provide a mechanism for residents and businesses to install improvements that may outlast their tenure. Because the payment is tied to the meter, not the property owner, TIPs allow for the current occupant to move, with the next occupant responsible for repayment. Typically, the monthly charge must be less than the expected savings from the efficiency improvements and charged for a period less than the life of the efficiency measure being installed. Failure to pay can result in utility disconnection for most TIP programs. TIPs may offer a useful mechanism for rented properties where the split incentives between property owners and tenants chronically lead to underinvestment in energy efficiency. The Pay As You Save® (PAYS) system is a proscribed TIP design.[11] Its features include independent verification of savings estimates to assure savings, a requirement that the expected annual payment be less than the estimated annual savings, and that the term of repayments be less than the life of the measure. All participants in programs based on the PAYS system are assured that if measures fail, they will be fixed or the payment obligation will end, that repair costs will not increase the monthly payment amount, and that bonding and contractor certification will ensure post inspection and warranty problems will be satisfactorily resolved. The developers of PAYS believe these features are integral to achieving widespread savings, availability of capital, and substantial program participation. As a tariff, TIPs require the support of implementing utilities and approval from the utility regulators.

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[8] U.S. Environmental Protection Agency, "Financing Guidebook for Energy Efficiency Program Sponsors" (December 2007).

[9] An EIM, which allows the buyer to borrow more money to invest in efficiency improvements, is different than a Energy Efficiency Mortgage (EEM), which gives an efficient home a more favorable mortgage interest rate.

[10] Faesy, Richard, "Understanding and Overcoming the Energy Mortgage Barrier," ACEEE Summer Study on Energy Efficiency in Buildings (2000).

[11] More information contact the Energy Efficiency Institute: http://www.eeivt.com

COLLECTION MECHANISMS

Most financing models, such as credit cards, collect payments with a separate monthly bill. However, there is growing interest in putting the payment on the utility bill (i.e. on-bill financing) or property tax bill, to make repayment easier and more reliable. Energy Financing Districts usually collect repayments through the property tax bill.

ENHANCEMENTS

This category is a catch-all for the ways that programs have "enhanced" their product by making it more appealing or accessible than what is available in the market. Enhancements can include the following:

Reduced Interest Rates
Often programs offer below-market interest rates, or offer buy downs of a certain percentage; this is usually funded through a public benefit charge or through a lower-interest source of capital that borrowers do not have access to outside of the program.

Guarantees and Reserves
Guaranteeing loans or pre-funding reserves (funds set aside to cover defaults) enable lenders to offer loans to a wider group of borrowers, and also allow lenders to offer lower interest rates because of security provided by the guarantee. There are efforts currently underway to secure federal credit enhancement of Energy Financing District bonds.

The City of Berkeley funds a debt service reserve fund at 6.5% of the total outstanding principal amount to cover bond debt service in the case of late payments by the property owners – bond investors typically expect a debt service reserve fund. It should be noted that the City of Berkeley funded this reserve fund from its general fund rather than asking property owners to bear the cost, which most local agencies will not be willing to do.

In addition, because the City did not wish to initiate early foreclosure on delinquent properties (which is a typical feature of land-secured bonds in California), the City agreed to pay delinquent special taxes with "available surplus funds"; again many local agencies probably may not be willing to provide this type of credit enhancement.[12]

Rebates for Efficiency and Solar
A common way to enhance a financing program is by providing a direct payment for implementing certain measures to offset some of the project cost. These exist for both efficiency and solar energy in many states, and can be used to make the project more attractive.

Subsidized Transaction Costs
Some programs offer free audits or cover the costs of "handholding" a customer through the process to reduce transaction costs.

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[12] Under the Alternative Method of Distribution of Tax Levies and Collections and of Tax Sale Proceeds (the "Teeter Plan"), a county may guarantee the payment of special taxes and assessments, and, in return, the county collects and retains all penalties and interest which accrue on the delinquent special taxes and assessments. There are also programs in which tax delinquencies are sold to third parties who assume the "Teeter" role typically played by counties.

Including Energy Costs and Savings in the Underwriting Criteria

One credit enhancement is for the lenders to include the energy savings on the income side when they are evaluating a borrower's credit using a debt-to-income ratio.

There are a few other enhancements that so far have rarely been used, but that may have potential. One possibility is to aggregate the projects to the extent that a group of projects can get lower rates for products and services. Another idea is to sell the environmental or renewable energy benefits of the project into a market that values them to lower the project cost for participants. This could be a renewable energy credit (REC) market or an energy efficiency market; REC markets exist in many states (including some that require specific amounts of solar energy - see the DSIRE website for states with these programs - http://www.dsireusa.org) and markets for "energy saving credits" have been developed recently in a few countries in Europe.[13] To get economies of scale, residential projects would need to be aggregated and sold to these markets in substantially larger units than one house at a time. Of course, by selling off these attributes of the project, participants and cities forfeit the right to claim these attributes towards their own goals.

Another option that may be possible is for a municipality to arrange for a third party to pay for and own the installed measures during the repayment period. Ownership would transfer to the building owner at the end of the payment period. If the repayment was structured so that the IRS characterized the arrangement as a rental arrangement (i.e., the investor rents the equipment to the consumer) then the investor may be eligible for one of the renewable tax credits (if there is a business credit available). Such a structure could enable tax advantaged investors to monetize the value of available tax credits.

UNDERWRITING CRITERIA

Underwriting is the process of determining whether an applicant is credit worthy enough to receive financing. The traditional measures for evaluation are the applicant's debt-to-income ratio and FICO[14] score, which is a score used by the credit rating industry to represent credit worthiness based on bill payment histories, current debt, and other criteria. Proxies for credit such as a utility bill or a property tax bill payment history can also be used. Although the underwriting criteria for Energy Financing Districts are still evolving, clean property title records and tax records ultimately may be determined to be sufficient.

SECURITY INTERESTS

Many financing program offer unsecured loans, which are not attached to any of the borrower's assets and have higher interest rates. Other programs, especially those with higher loan limits, tend to use some type of lien for security. A lien is a security interest in an item of property to secure the payment of a debt or some other obligation. A lien on the real estate itself is a mortgage. A Uniform Commercial Code[15] fixture filing is a lien attached to the "fixtures" installed that is recorded with the property title and must be paid in the event of the foreclosure or sale of the home. A lien can also be placed on other valuable assets such as a car or boat. In addition to these traditional methods of acquiring a security interest, some programs use the ability to disconnect power for nonpayment for added security. Energy Financing Districts use a lien attached to the property.

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[13] Vine, E. and J. Hamrin, "Energy savings certificates: A market-based tool for reducing greenhouse gas emissions." Energy Policy, 2008. 36(1): p. 467-476.

[14] FICO scores are commonly used evaluate the credit worthiness of an individual. They are calculated using a method developed by the Fair Isaac Corporation.

[15] The Uniform Commercial Code is a body of recommended laws regarding sales and commercial transaction that are meant to harmonize the laws in various states. Form to create a UCC fixture filing available at: http://www.sos.ca.gov/business/ucc/ra_9_ucc-1.pdf

4. Case Studies

The four most established Energy Financing Districts in the United States are in Berkeley, CA; Palm Desert, CA; Boulder County, CO; and Babylon, NY. These programs have all taken slightly different approaches to dealing with the challenges and program design issues presented in sections 4-9. For ease of comparison, a summary chart is provided after the case studies.

BERKELEY FIRST, BERKELEY, CALIFORNIA

In November 2006, 81% of Berkeley voters endorsed ballot Measure G, which established an aggressive greenhouse gas (GHG) reduction target of 80% by 2050 and directed the City to develop a plan for achieving that target. As part of the effort to reduce emissions, Berkeley city staff developed the concept for the Berkeley Financing Initiative for Renewable and Solar Technology (FIRST) to enable residents and businesses to finance energy improvements to their buildings.

The pilot launched in November 2008 and Berkeley property owners reserved the $1 million of initial funding within 10 minutes of opening the application website. This included 38 residential projects with an average project value of $28,000. Funding comes from issuing "micro" bonds for each project that are purchased by the city's financial partner. Each bond is secured by all of the special taxes paid by participating property owners. Only solar PV was allowed for the pilot round, though basic energy efficiency improvements were required before installing solar. The City is currently evaluating the pilot and assessing the potential to launch a full program that would include energy efficiency and solar energy projects and the merits of proceeding individually or jointly with other governments. For the evaluation phase, the City received permission from participants to use utility bill data and information on the measures installed by each household to track the energy savings from the program and savings per dollar invested.

Contact: Daniel Lambert, Berkeley FIRST Program Manager
DLambert@ci.berkeley.ca.us
http://cityofberkeley.info\sustainable
http://www.berkeleyfirst.renewfund.com

ENERGY INDEPENDENCE PROGRAM (EIP), PALM DESERT, CALIFORNIA

The City of Palm Desert's Office of Energy Management (OEM), founded in January 2007, has a city-wide goal of reducing energy use by 30% in five years. To achieve this goal, the city created its Set to Save program, which provides incentives for energy efficiency in partnership with Southern California Gas Company and Southern California Edison. The OEM saw a need for financing energy projects, which led to the creation of their financing program. The EIP funds energy efficiency and solar energy projects for residential, commercial, and industrial properties under the authority provided by California's AB 811. The City keeps track of what measures are funded, and energy savings are estimated based on the California Energy Commission's Database for Energy Efficient Resources (DEER) values for energy efficiency improvements. For privacy reasons, the City has chosen not to try to gain access to utility bills. However, they do have a few select properties whose energy consumption they track in real time.

The EIP committed $7.5 million in its first two phases. The first $2.5 million from the city's general fund for Phase I was committed within 3 weeks; Phase II funding of $5 million from a bond issued by the city's Redevelopment Agency was committed in just over 5 weeks. There were 206 project applications for Phase I and Phase II, an average of $36,000 per project and all but three were residential projects. Only one solar thermal project was funded. Most of the energy efficiency projects were for high performance air conditioning, pool pumps, roof insulation, and windows. Solar PV projects accounted for only 98 of the projects but almost 70% of the funding. For Phase III, the City plans to set aside a portion of the financing for energy efficiency to ensure that there is sufficient money to finance energy efficiency upgrades, which are often more cost effective than solar PV.

Contact: Patrick Conlon, Director of the Office of Energy Management
pconlon@ci.palm-desert.ca.us
http://www.cityofpalmdesert.org/Index.aspx?page=484

CLIMATESMART LOAN PROGRAM, BOULDER COUNTY, COLORADO

Boulder County created the ClimateSmart Loan Program to support Boulder County's goal of achieving Kyoto Protocol targets and long-term carbon neutrality. The statewide enabling legislation HB 08-1350 passed in May 2008, Boulder County voters passed Ballot Measure 1A to authorize $40 million in bonding capacity for the ClimateSmart Loan Program in November 2008, and the program began accepting applications in April 2009. The program is available to the unincorporated county residents and nine of the county's ten municipalities. Eligible improvements include: air sealing and ventilation, insulation, space heating and cooling, water heating, lighting retrofits, daylighting, windows doors and skylights, reflective roofs, pool equipment, landscaping (e.g. planting trees on south side of house), solar hot water, solar PV, small wind, and wood/pellet stoves.

Before the program launch, 1,700 people attended the required participant workshops and over 130 contractors attended briefings about the program. The program is set up so that applications are taken before the county issues the bonds. The first application period in April 2009 closed with 393 applications for over $7.5 million in financing. The projects include a wide range of energy efficiency and renewable energy measures, in fact Boulder County is the most ambitious to date in terms of eligible project scope. The county then issued a bond to cover this amount of funding. For the evaluation phase, the County will use utility bill data and information on the measures installed by each household to track the energy savings from the program and savings per dollar invested. The County will have access to utility bill data because they require each participant in the program to sign a utility bill release. They will also be able to track people who have participated in other County programs, such those who have completed a home energy audit but have not followed through with getting energy efficiency projects; thus, there is an opportunity for more targeted outreach.

Contact: Ann Livingston, Sustainability Coordinator for the Boulder County Commissioners' Office
alivingston@bouldercounty.org
http://www.climatesmartloanprogram.org

LONG ISLAND GREEN HOMES PROGRAM, BABYLON, NEW YORK

The Long Island Green Homes Program supports a broad set of policies to encourage energy efficiency in Babylon, a town on the south shore of Long Island. In 2006, Babylon developed a comprehensive green building code and became the first Long Island town to adopt aggressive energy efficiency standards consistent with the ENERGY STAR New Homes performance standards for new home construction and to require LEED-certification for all new commercial buildings over 4,000 sq ft. The Town also adopted the 12X12 Initiative to Combat Global Warming (a program of the Sierra Club), committing Babylon to reducing its greenhouse gas emissions 12% by 2012.

To implement their financing program, the definition of solid waste was expanded to include CO2 so that $2.5 million of the Town's solid waste reserve fund could be used to finance energy retrofits. The program funds cost-effective energy efficiency measures such as air sealing, insulation, caulking, and replacing space heating and hot water systems. The program can also finance solar energy improvements, but only if the home already meets the Energy Star standard for new home construction. Thus far, 169 homeowners have submitted applications for approximately $1.2 million in funding. The average project costs $7,100 and is expected to save 28% of the home's energy use.

Contact: Dorian Dale, Energy Director for the Town of Babylon
ddale@townofbabylon.com
http://ligreenhomes.com
http://www.TheBabylonProject.org

CASE STUDY COMPARISON CHART

	PROGRAM LAUNCHED	POPULATION DENSITY HOUSING UNITS % RENTAL UNITS	MEDIAN FAMILY INCOME	SOURCE OF CAPITAL	FINANCING MECHANISM	COLLECTION MECHANISM	ELIGIBLE MEASURES	CREDIT REQUIREMENTS	SECURITY	RATE TERM MAX AMT	WHO PROCESSES APPLICATION?	LOCAL GOVT STAFF	RESULTS AS OF AUGUST 2009
BERKELEY, CALIFORNIA	Nov 2008	110,000 pp 9,800 pp/sqmi 46,600 units 54% rental units	$86K	"Micro" bond sold to financial partner	Special tax (Mello-Roos)	Property tax bill	Solar PV (pilot)	Clear title & good property tax payment history	Senior lien on property	7.75% 20 years $37,500	Third party	1.25 FTE	38 projects $28,000 ave/ per $1M committed
PALM DESERT, CALIFORNIA	Oct 2008	51,000 pp 1,600 pp/sqmi 33,500 units 34% rental units	$70K	City's general fund for Phase I, then Redevelopment Agency bonds, now seeking a financing partner for Phase III	Assessment (AB 811)	Property tax bill	Energy efficiency, solar thermal, solar PV	Clear title & good property tax payment history	Senior lien on property	7% up to 20 years No max	City staff	1.5 FTE	206 projects $36,000 ave/ per $7.5M committed
BOULDER COUNTY, COLORADO	April 2009	300,000 pp 400 pp/sqmi 123,000 units 34% rental units	$84K	County issues bonds	Assessment (HB 08-1350)	Property tax bill	Energy efficiency and variety of renewables	Clear title & good property tax payment history	Senior lien on property	Varies (6.68% for 1st round) 15 years $50,000	County staff with third party support	1-2 FTE	393 projects $19,000 ave/ per $7.5M committed
BABYLON, NEW YORK	August 2008	220,000 pp 4,100 pp/sqmi 74,000 units 20% rental units	$84K	Municipal solid waste revolving fund	Assessment (amended solid waste code)	Separate bill, transfers to property tax bill if delinquent	Energy efficiency, solar thermal, solar PV	Clear title & good property tax payment history	Senior lien on property	3% term varies $12,000	City staff	3 FTE	169 projects $7,100 ave/ per $1.2M committed

5. Identifying the Demand in Your Community

Municipalities initially looking into Energy Financing Districts often ask: "How many people will participate?" The answer to this question will vary widely based on the demographics of the population, the benefits that can be expected given the local climate and quality of the building stock, other financing options and incentives available, the way participant risk is addressed, and the effectiveness of the program's outreach and marketing efforts, as discussed in Section 10. In general, programs become much less expensive with economies of scale that spread fixed program costs over a large number of participants. To begin to get a handle on the potential for the program, it will be useful to understand the following factors:

→ DEMOGRAPHICS

Important information includes the number, age and condition of single and multi-family homes, and the composition of the commercial building stock. The number of rental properties where the tenants are responsible for the utility bills is also an important factor. Social factors such as the level of interest in and knowledge about energy options will also be important to gauge how much education is needed to spark interest in the program. The City of Berkeley conducted an initial web survey of city residents to explore these more qualitative factors, which is included in the resource list found in Section 12.

→ EXPECTED BENEFITS

The benefits of the program will vary with climate, the quality and age of buildings, energy prices, and other factors. For example, the benefits of solar PV will be greater in places with a lot of sun, high electricity rates, higher midday rates, high energy demand, net metering laws, and a high prevalence of south-facing roofs with few obstructions (such as trees). Energy efficiency opportunities will be greater in communities with heavy heating and/or cooling loads, high electricity and gas rates, and buildings that have many opportunities for low-cost efficiency upgrades. Talking to local solar installers and energy efficiency contractors will be important to gauge the potential value of savings to property owners.

→ PERCEIVED BARRIERS

It will be important to assess what the perceived barriers are for potential customers. Why are they not pursuing this now? Is lack of financing an important issue, or are there a number of other barriers such as lack of interest or information that are the real barriers to adoption? These additional barriers will need to be addressed or the program will experience low demand despite eliminating the barrier of first cost.

→ OTHER FINANCING AND INCENTIVES AVAILABLE

It is important to do an assessment of other financing options currently available. These include products available from local banks, credit unions, community development financial institutions (CDFIs), or the local utility. Contact the banking association in your state and ask about rates for secured and unsecured loans, and also their level of demand for financing for efficiency and renewables. Ask local contractors if they currently offer any financing products to their customers. Also check with the local utility to see what incentives are available, including annual limits on funding, whether such funds are currently being fully utilized by their customers each year, and what the penetration rates have been for existing programs. A key resource to check the availability of state and local financing programs and other incentives is DSIRE: http://www.dsireusa.org.

➔ OPPORTUNITIES FOR OUTREACH AND EDUCATION

Outreach efforts will play an important role in the success of the program. Low levels of understanding about climate change or lack of information about clean energy options will make the task of marketing the program more difficult. Identifying existing means within the community to disseminate public information is a first step. It is vital to connect with local community organizations, such as neighborhood associations, small business councils, local nonprofits, rotary clubs, religious groups, and other organizations. These groups can become ambassadors for the program.

It is also important to identify and engage the local solar installers and energy efficiency contractors – these businesses will be on the front lines of educating customers about clean energy improvements, and many successful programs use the contractors as the primary marketing force. You may want to do a survey and/or focus groups to collect more information from these groups. The City of Berkeley conducted four focus groups with solar PV contractors, energy efficiency contractors, solar thermal (hot water and space heating) contractors, and solar equipment suppliers. These sessions were extremely helpful both to engage these stakeholders, and also to get feedback on how to design the program. The script for the focus group and a summary of the finding are available through the link to resources in Section 12.

6. Legal Authority

The creation of an Energy Financing District will likely require state statutory authorization as well as approval by the local government entity (e.g. city council or county board of supervisors), though laws vary from state to state. In California, state law enables this type of financing through two options: a special tax financing (which is an option that is currently available only to charter cities, although amendments to the Mello-Roos Community Facilities Act of 1982 for this purpose are pending) or a contractual assessment financing (authorized by amendments to the 1911 Improvement Act by AB 811).

This section first describes the state statutory authority in California, and then provides guidance for amending laws in other states to provide for the creation of Energy Financing Districts. The legal requirements vary greatly from state to state. Links to the text of the existing enabling legislation and other relevant documents from California, Colorado, and New Mexico are provided in Section 12, along with a link to additional legal guidance for Arizona, Florida, Hawai'i, Michigan, Nevada, New Jersey, New Mexico, New York, Oregon, Texas, and Washington. The legislation for all states with legal authority for this type of financing can be found at http://www.dsireusa.org under the policy category called "Property Tax Financing Authorization".

CALIFORNIA ENERGY FINANCING DISTRICTS: SPECIAL TAXES AND ASSESSMENTS

As explained above, Chapter 29 of the 1911 Improvement Act, as amended by AB 811 in 2008, gives cities and counties authority to levy contractual assessments to finance renewable energy and energy improvements on private property. The City of Palm Desert used this contractual assessment method.

The City of Berkeley, as a charter city with legal authority over "municipal affairs", adopted a special tax financing ordinance based on the Mello-Roos Community Facilities District Act of 1982 (the "Mello-Roos Act"), which authorizes local agencies in California to create community facilities districts, issue bonds, and levy special taxes to finance public facilities, public services and certain improvements to private property. Berkeley used its charter powers because the Mello-Roos Act does not currently authorize local agencies to finance energy projects for private property, although amendments (Senate Bill 279) are currently pending for that purpose. Any charter city[16] in California can adopt its own special tax financing law to adapt Mello-Roos for this purpose.

To set up an AB 811 financing program, the legislative body of the city or county must adopt a resolution of intention, direct a city official to prepare a report, hold a public hearing on the matters covered by the report, then approve the report and a contractual assessment financing program. The report must include a map of the territory within which contractual assessments are proposed, a draft contract between a property owner and the city, city policies concerning contractual assessments, a plan for raising capital to finance the improvements, and the amount of fees that will be charged to the city or county for incorporating the assessments into the general tax assessments for the city or county. Municipalities will need to consider how California Constitution Article XIIID, which was enacted by Proposition 218, impacts the contractual assessment process; we recommend consulting with your city attorney, county counsel or bond counsel to review this issue.

Under California's Mello-Roos-based financing law, the process for authorizing the levy of special taxes and issuance of bonds requires four phases. In the first phase, the City Council of a charter city must adopt a special tax code that authorizes the Energy Financing District; this step will be eliminated if the Mello-Roos Act is amended for this purpose. In the second phase, following a public hearing, the City Council creates a special tax district and authorizes the levy of special taxes on properties that vote in favor of being taxed. In the third phase, property owners vote in favor of the levy of special taxes on their property and the issuance of bonds. In the fourth phase, which will be repeated with every round of funding, the City Council authorizes the issuance of the bonds payable from special taxes. A pending bill in the California legislature, SB 279, would, if passed, extend the ability to use special tax districts to all local agencies (including non-charter cities, counties, water districts, public utilities, etc.) and would reduce the steps required for the process to authorize the levy of special taxes by eliminating the "first phase" described above.

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[16] Outside of California "charter" cities are also referred to "home rule" cities and towns. As explained above, charter cities in California have authority over "municipal affairs" subject to constitutional limitations.

MELLO-ROOS VS. AB 811

Many believe that the public finance community in California must eventually agree on whether to use assessment financing or special tax financing. In the meantime, assessment financing is available to all cities and counties while special tax financing is available only to charter cities. There are a few important differences between the two options:

- The Mello-Roos adaptation is currently only available to charter cities, as a result, the implementation process is considerably more involved than the AB 811 process; however, if SB 279 passes it will be available to all local agencies and the implementation process will be simplified
- AB 811 is only available to cities and counties (not other local agencies)
- AB 811 may be subject to the requirements of Article XIIID of the California Constitution (please consult with your city attorney, county counsel or bond counsel on this issue)
- SB 279 would allow for third-party ownership and lease financing
- AB 811 is not available for "parcels which are undergoing development" e.g. residential and commercial new construction (although it is possible that this distinction may be eliminated during the legislative process for SB 279)
- Neither would allow financing of power purchase agreements (PPAs)

Again, we recommend consulting with your city attorney, county counsel or bond counsel to review whether you should utilize AB 811 or Mello-Roos for an Energy Financing District in your community.

IMPLICATIONS FOR NEW CONSTRUCTION & THIRD PARTY OWNERSHIP

> *An Energy Financing District could support the development of new "zero-energy" homes and commercial properties with many of the energy efficiency and renewable energy features funded through the program. This would reduce the considerable misalignment of interests between the builder and the initial buyer of a new property.*

The limitations of AB 811 Assessment Districts for new construction may be an important issue for local governments to consider, particularly in regions that expect new construction to be a significant element of the future housing stock. An Energy Financing District could support the development of new "zero-energy" homes and commercial properties with many of the energy efficiency and renewable energy features funded through the program. This would reduce the considerable misalignment of interests between the builder and the initial buyer of a new property. Enabling builders to add energy efficiency and renewable energy features during the construction process will also significantly reduce the cost of these measures.

Third party ownership (only allowed under SB 279, if passed), where an investor retains ownership for tax purposes, is also an interesting situation to consider. Presently, the initial owner takes the federal income tax credit (ITC) for solar or efficiency up front, but subsequent owners will pay higher (than necessary) special taxes as a result because they do not get a share of the ITC. A third party owner could take the tax credits up front and reduce the total amount financed through the Energy Financing District, thus reducing the payments of future property owners.

BOULDER COUNTY

The state of Colorado passed House Bill 08-1350 in May 2008, led by Boulder County and local delegate Representative Alice Madden. This bill allows counties and other local government entities to provide below-market financing for renewable energy and energy efficiency improvements on their properties via a "Clean Energy Options Local Improvement District." The bill allows for the use of tax-exempt bonds and taxable bonds to finance projects. Boulder County's district was established under Ballot Measure 1A, approved by voters in November 2008. Additional regional and statewide programs, based on Boulder County's ClimateSmart Loan Program model, are currently being considered.

BABYLON

Babylon uses a different mechanism than the other programs. In Babylon, residents already pay a biannual benefit assessment fee to the Town for removing solid waste. To implement their financing program, the definition of solid waste was expanded to include energy waste in the form of CO2, so that the Town's solid waste reserve fund could be used to finance energy retrofits. This required the Town Board to approve a resolution amending the Town's Solid Waste Code. This mechanism should be feasible for other towns where residents already pay a similar benefit assessment. In fact, both houses of the New York legislature just affirmed the "carbon as waste" rationale, thus enabling any municipality in the state to set up a waste district for this purpose. Enabling legislation may be necessary in other states.

GUIDANCE FOR OTHER STATES[17]

Most states in the U.S. have some form of local government special assessment district authority that enables municipalities to collect assessments on the property tax bill from property owners within their jurisdiction to finance improvements that benefit such property owners, and to finance the up-front costs of such improvements by issuing bonds. Generally, the simplest method of creating authority is to use this existing assessment district authority, and, if necessary, to amend the relevant section of the state code to expressly provide for the key features of a financing program.[18]

The key features that often must be added to existing state law to enable Energy Financing Districts include the following:

Authority to Finance Improvements on Private Property
In some states, the statutes authorizing local governments to create assessment districts specify that the

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[17] This section was kindly prepared by Sheridan Pauker at Wilson Sonsini Goodrich and Rosati.

[18] A memorandum prepared for the Vote Solar Initiative by Wilson Sonsini Goodrich and Rosati, PC, that describes the assessment district authority in various states and amendments to state law necessary to implement Energy Financing Districts, can be found at: http://www.votesolar.org/linked-docs/key_states_memo.pdf

improvements to be financed by such assessments must serve a "public purpose." It is therefore sometimes necessary to amend the state code to provide that renewable energy and energy efficiency improvements on private property are a valid public purpose. This can be done using express language and via legislative findings. If state law must be amended in any way to provide the authority for creating an Energy Financing District, we recommend using both language stating that renewable energy and energy efficiency improvements to private property may be financed through the assessment district, and also findings of the governing body to the effect that the financing of such improvements serves a valid public purpose (such as reducing greenhouse gas emissions and improving air quality).[19] Other states expressly prohibit the use of assessment districts to develop private property. In such states, the code sections authorizing assessment districts must be amended to authorize the financing of renewable energy and energy efficiency improvements on private property. Again, if the state statute must be amended for any reason to create this authority, it is generally a good idea to include such language to clarify the local government's intent and prevent later misunderstandings.

Authority to Finance Renewable Energy and Energy Efficiency Improvements
State law authorizing the creation of assessment districts often limits the authority of local governments to financing only certain enumerated types of improvements, such as sidewalks, parks, sewers, and the like. In such states, to enable the authority to create Energy Financing Districts, it is necessary to expand this list to specifically include renewable energy and energy efficiency improvements.

Opt-In Feature
In most states, when assessment districts are created by the governing body of a municipality, the governing body must designate the geographic boundaries of the district, and all parcels of property on the tax roll for such designated area are included in the district. In the Energy Financing Districts model, a particular parcel of property is not assessed unless that property owner "opts-in" and applies to participate in the program. To create the legal authority for this "opt-in" mechanism, the code section authorizing assessment districts must usually be amended to provide that, when creating an Energy Financing District, the governing body of the municipality may initially designate a geographic area comprised solely of properties proposed for annexation into the district. Then, once the district is created, properties only join the Energy Financing District (and thereby become eligible for financing of the improvements and subject to special assessments) when all of the owners of a particular property voluntarily decide to annex their property into the district.

The particular amendments necessary to provide local governments with the authority to implement an Energy Financing District will depend on the law of the specific state at issue. In some states such as Michigan, for example, the authority to create assessment districts is scattered among different sections of the state code that apply to different types of local government entities (i.e. towns, cities, counties, etc.). In these circumstances, or where the general authority to create assessment is overly complex and incongruous with the Energy Financing District model, it may be necessary to implement "stand alone" authority that creates a new code section specifically geared toward Energy Financing Districts. An example of such "stand alone" legislation (as opposed to models that build on and amend existing assessment district authority) is HB 1391, proposed by Texas Representative Mark Strama.

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[19] AB 811 provides a good example of such legislative findings. See California Streets and Highways Code section 5898.14.

7. The Financing Mechanism

> *There are two factors that differentiate Energy Financing Districts from other types of financing for privately-owned renewable energy/energy efficiency improvements: 1) the addition of an assessment or special tax on the property tax bill, backed up by a lien on the property, which makes the investment extremely secure, and 2) the attachment of the repayment responsibility to the property instead of the individual.*

There are two factors that differentiate Energy Financing Districts from other types of financing for privately-owned renewable energy/energy efficiency improvements: 1) the addition of an assessment or special tax on the property tax bill, backed up by a lien on the property, which makes the investment extremely secure, and 2) the attachment of the repayment responsibility to the property instead of the individual, which encourages the owner to invest in energy upgrades even if he or she is going to sell the property before recouping his or her full investment. This section describes how the financing mechanism works for Berkeley along with examples from the other cases, the process that Berkeley uses to arrange the financing, and the use of financing partners.

THE CALIFORNIA MODEL

Energy Financing Districts allow property owners to "opt in" to the program, whether an assessment district or a special tax district to fund improvements to their property. Participants repay the costs of the improvements through a special tax or assessment added to their property tax bill. To initiate the financing, the property owner executes a single document (a Unanimous Approval under Berkeley's program; a contract under AB 811 programs) and the local government records a notice of the special tax or assessment in the real property records as a lien against the property (a Notice of Special Tax lien under Berkeley's program; a Notice of Assessment under AB 811 programs). These actions combine to impose a senior lien to secure the obligation to pay special taxes or assessments, and delinquent special taxes or assessments are paid before a property's first mortgage in the case of foreclosure. The fact that special taxes and assessments are paid first means that bonds secured by special taxes or assessments are extremely secure.

Berkeley's special tax financing law (which is based on the Mello-Roos Act) and AB 811 programs give interested parties two opportunities to challenge the special tax or assessment lien: during the initial public hearing and within a period of time after recordation of the notice of the lien, which is called the statute of limitations. In California, the statute of limitations in AB 811 proceedings runs for 30 days after recordation of the Notice of Assessment. The statute of limitations under the proposed SB 279 would similarly be tied to recordation of the Notice of Special Tax Lien.

Existing lenders on commercial and residential property are likely to be concerned about Energy Financing Districts because of the senior nature of the lien, particularly in markets with declining property values. In those markets, it may be advisable to wait until home prices have stabilized somewhat, or to require a minimum loan-to-value ratio. Because many deeds of trust securing purchase money loans on properties in California may give lenders certain rights in the event a senior tax or assessment lien is placed on a property, local agencies may also want to encourage or even require property owners to secure an acknowledgement from their lenders that participation in the Energy Financing District will not result in the exercise of remedies under the deed of trust. This is another matter on which you should consult with your city attorney, county counsel or bond counsel.

Most property owners who fail to pay their taxes once or twice end up paying them back before their home is foreclosed (or, if the lender is simultaneously foreclosing on a delinquent purchase money loan, the lender may pay delinquent taxes and assessments in order to preserve its junior lien), so allowing some leeway for late payments is advisable to reduce costs, although the land-secured bond market typically demands an early-foreclosure covenant from local government issuers. When a local government issues bonds, investors will typically require a debt service reserve fund that can be used to pay debt service in the event of special tax or assessment delinquencies. The reserve fund is replenished when the delinquent special taxes or assessments are ultimately collected. The City of Berkeley established a reserve fund equal to 6.5% of the outstanding principal amount of its bonds, which it funded from its general fund. In addition, as described above, because the City of Berkeley did not want to agree to an early-foreclosure covenant (instead, the City preferred to allow foreclosure to be initiated by the County after five years of delinquencies), it agreed to pay delinquent special taxes from "available surplus funds". Many cities will not be willing to fund a debt service reserve fund from their general fund and may not be willing to pay delinquent special taxes. As a result, these important security issues are still evolving.

If the property is sold prior to the end of the repayment period, the new owner takes over the remaining special tax payments as part of the property's regular tax bill. New owners are notified of the repayment obligation before they purchase the property as a result of recordation of the Notice of Special Tax Lien; a title search will reveal the rate schedule for the repayments. The local government should also keep more detailed records about the improvements made in case the new owner requests this information. The long repayment period and transferability of the payments allows property owners to invest in comprehensive energy savings and renewable energy projects that pay back over a longer time frame than many existing financing options allow.

The interest component of special taxes and assessments are tax deductible at the federal level, similar to interest paid on a home mortgage, which is a significant financial benefit to the property owner. To help property owners identify the interest component of their special tax payments, the City of Berkeley creates a schedule of special tax payments that separately identifies the interest, principal and administrative expense component of each payment. The interest rate will vary between programs depending on the source of funding and how much of the program's administrative cost is built in to the interest rate.

PROTECTION OF LOCAL GOVERNMENT GENERAL FUNDS

In general, local governments are concerned about any risk to their general funds. Berkeley chose to use special tax revenue bonds that are payable only from special taxes and the proceeds of foreclosure in the event of delinquency. The City of Berkeley's bonds are not a "general obligation" of the City – the debt does not count against the city's debt limit, nor does it impact Berkeley's credit rating or otherwise create a direct liability to the city's general fund. Similarly, assessment bonds issued by a California city or county to finance renewable energy and energy efficiency improvements will typically be payable only from contractual assessments levied under AB 811.

THE SOURCE OF FUNDING

In its pilot program, Berkeley issues bonds with an interest rate equal to 3.25% above the 10-year U.S. Treasury Note or 6.75%, whichever is greater. Each property owner may finance up to $37,500 of improvements in the pilot program. Initial and on-going administrative fees are built into the special taxes paid by the property owners and add approximately 1% to the effective interest rate paid by the property owner, which is currently at 7.75%. In the pilot phase Berkeley committed over $1 million in funds for solar PV projects. Berkeley issues a "micro" bond for each project so that it can guarantee available funding at a set interest rate on demand. One of the issues with funding many small projects is that issuing many small bonds can be extremely expensive. Berkeley has contracted with a third party, Renewable Funding, to buy the "micro" bonds that are issued for each project. Renewable Funding has the right to aggregate the bonds and resell them in the market. These bonds are taxable to the investor at the federal level, but exempt from state income taxes in California. Several municipalities are advocating for changes to the federal tax code to allow tax-exempt bonds to be used for these programs.

The Appendix contains language from the American Clean Energy and Security Act of 2009, passed by the House of Representatives in June 2009, that would allow the federal government to provide credit support, including the commitment to purchase bonds, for municipalities implementing Energy Financing Districts.

FINANCING PARTNERS AND PROCESS

Depending on the capacity and expertise of the local government, it may be helpful to engage financial and service partners to provide support. The Requests for Proposals and the partner contracts from Berkeley for these services are in Section 12. Most cities will want the bonds to be purchased by a third party, although Palm Desert and Sonoma provided initial financing for their programs. In addition, cities may want a third party to help with the "front end" administration of a program, including interaction with applicants and review of the city's credit criteria for funding. And cities may want a third party to help with the "back end" administration, including placing the special tax or assessment levy on the county property tax roll, interaction with delinquent property owners, etc.

The process and actors involved in the pilot phase of Berkeley's financing arrangement are shown in the table below. Berkeley works with Renewable Funding in two separate roles: as the program administrator and as the bond purchaser. Jones Hall is the City's bond counsel, and The Bank of New York Mellon is the City's fiscal agent/trustee. The basic process is as follows:

1. The participant applies for financing.
2. Renewable Funding, in its role as a service provider to the City, reviews and approves the application according to standards established by the City.
3. The property owner contracts with an installer and installs the improvements.
4. The participant requests funding for the installed improvements, which includes execution of a Unanimous Approval by which the property owner votes in favor of the levy of special taxes on its property and the issuance of bonds
5. The City records the Notice of Special Tax Lien and issues a bond to fund the individual project.
6. Renewable Funding, as the bond investor for the pilot program, buys the bond.
7. The City issues a check to the property owner and adds the special tax to the property tax rolls.
8. The County levies special taxes, collects the special tax payments and pays the special taxes to the City.
9. The City's fiscal agent, The Bank of New York Mellon, makes the bond interest and principal payments with special tax revenues received by the City.

BERKELEY FIRST SUMMARY OF CLOSING AND TRANSFER PROCEDURES

CATEGORY		ACTIONS	RESPONSIBILITY	DOCUMENTS
FUNDING REQUEST				
Document Preparation	1	Property owner requests funding on-line	Property Owner	
	2	RF notifies City and Financial Advisor of request	RF	
	3	RF and Financial Advisor prepare FIRST documents	RF and Financial Advisor	FIRST docs and Payment Schedule
	4	RF delivers FIRST documents to property owner via email and mail	RF	Unsigned FIRST docs
	5	Property owner signs, notarizes and return FIRST documents	RF	Signed FIRST docs
Document Review and Delivery	6	RF notifies City of document receipt	RF	
	7	RF reviews documents to ensure completeness	RF	
	8	RF delivers documents to City & JH (by PDF)	RF	Notice of Special Tax Lien, Unanimous Consent, all original docs
BOND CLOSING				
Document Prepartion and Bond Issue	9	Recordation of Notice of Special Tax Lien	City	Notice of Special Tax Lien
	10	Issue, execution and authentication of Bond by City and BNY	City, Jones Hall & BNY	Executed and authenticated Bond
	11	Delivery of Bond executed by City and authenticated by BNY	Jones Hall	Executed and authenticated Bond
	12	Delivery of Bond Counsel Opinion	Jones Hall	Bond Counsel Opinion
	13	Delivery of certified Resolutions and Ordinances	City	Resolutions and Ordinances
	14	Delivery of Property Related/FIRST documents	City	FIRST Docs
	15	Delivery of City Closing Certificate	City and Jones Hall	City Closing Certificate (Exhibit B BPA)
	16	Delivery of Fiscal Agent Certificate	BNY and Jones Hall	FA Closing Certificate (Exhibit C BPA)
Bond Purchase	17	Deposit into Reserve Fund	City	Deposit equivalent 6.5% of project
	18	Delivery of RF Closing Certificate	RF	RF Closing Certificate (Exhibit D BPA)
	19	Delivery of Request for Authorization to Withdraw Funds	RF	Request for Authorization to Withdraw Funds (Exhibit A of Control Agreement)
	20	Delivery of Purchase Price via wire/check to City	RF	Wire Transfer
Check Delivery	21	Prepare & submit FN024 for check Issuance	City	FN024
	22	Delivery of Check to Property Owner	City	Check
	23	Delivery of Autorization to Withdraw Funds from Control Account	City	Authorization to Withdraw Funds
Payables Process	24	Hand billing 1st interest payment for financings before 6/15/09	City	City Tax Bill
	25	Transfer debt service payment to Special Tax Fund at BNY	City	Wire Transfer
	26	Special Tax Levy	City	Transmit new roll to County
	27	Bond Interest payment	BNY	Transmit to RF

RF = Renewable Funding (financing and admin partner)
JH = Jones Hall (city's bond counsel)
BNY = Bank of New York (city's fiscal agent)

PALM DESERT

Palm Desert has committed $7.5 million in the first two phases of its program. The initial capital of $2.5 million for phase I was provided by the city's general fund. An additional $5 million was provided for phase II of the program via bonds issued by the city's Redevelopment Agency, which the Agency continues to hold. Phase III funding is expected to be finalized by April 2009. In phases I and II, residents paid 7% interest over a term of up to 20 years. The minimum amount is $5,000; there is no maximum, although projects greater than $60,000 require approval from the City Manager and projects greater than $200,000 require approval from the City Council.

BOULDER COUNTY

The Boulder County program offers two types of funds. The first is funding through a limited amount of tax-exempt Private Activity bonds, which have a lower interest rate, may only be applied to primary residences, and will require applicants to show they make 115% or less of the area median income. The maximum amount that a property owner can obtain through these funds is $15,000. The second is funding through taxable bonds, which do not have income restrictions, and will fund up to $50,000 or 20% of the property's statutory actual value, whichever is less. Boulder County aggregates applications before issuing bonds. The term is 15 years and the interest rate will depend on the interest rate the County gets by selling bonds, but with a maximum of 8.75%. For the first round of funding, the rates were 5.2% for the income-qualified funds and 6.68% for the unrestricted funds. The program closed its first round of funding in April 2009 with 393 applications for a total of $7.5 million in financing.

BABYLON

Babylon reclassified CO2 as solid waste and tapped into the town's growing solid waste fund, $2.5 million of which it can now use as a revolving pool of funds for clean energy projects. The financing is tied to the property as a benefit assessment. Residents already receive a bi-annual bill for their solid waste benefit assessment; the energy benefit assessment is billed separately on a monthly basis. If the property owner is delinquent in paying this bill, the benefit assessment is transferred to the property tax bill. The interest rate is 3%, which covers administrative costs. The term and monthly payment amount of the benefit assessment fee is determined based on projected energy savings from the energy efficiency improvements; the term is chosen to match savings with the payments. To date the program has committed approximately $1.2 million to fund 169 projects.

8. Administration & Program Costs

Administration of the program is required on several levels. There need to be local government staff members that are ultimately responsible for the program - who oversee its development, manage the parties involved, and report progress to the City Council or other government body, the mayor, the city manager, or other supervisors. There is also a need for program marketing and a source of information if potential participants or the media have questions. Applications must be processed and approved, which should include checking the property title, tax records and any other requirements. Finally, there are financial functions such as preparing the property tax roll, making payments to participants, and debt service management. In summary, the main ongoing administrative areas are:

- General management, oversight, and coordination
- Marketing the program and responding to public requests for information
- Processing and approving applications
- Collecting appropriate documents and recording the tax liens
- Bond issuance
- Property Tax Administration- levying special tax or assessment
- Customer service and assistance
- Program evaluation

These roles can be filled by one person or several depending on the size and scope of the program. Some of these roles, such as the application processing, can also be subcontracted to a partner organization. The decision of how to manage the administration will be unique to the existing capacity and preference of each local government. To give a sense of some of the options, the administrative arrangements of our four case studies are described below. It is important to note that many of these functions require the same amount of staff time whether there are 50 applications or 500 - economies of scale are important for lowering costs. We also provide a hypothetical program budget to show how the costs for a program might break down, and which expenses are start up costs, initial costs per project, and ongoing costs.

BERKELEY

Berkeley does general program management with in-house staff, but contracts out many of the key activities to a third party organization, Renewable Funding. Renewable Funding hosts a website, the online application system, provides information for customers, checks the title, provides documentation, provides customer support and guidance throughout process, and collects the needed paper work to approve the application before the City issues a bond and financing. Specific roles for the administrative portion of the financing process are included in Section 7.

Berkeley's administrative budget for the first two years is $227,000, which covers many of the startup costs and the additional work required to develop a new concept. It also covers "extras" such as developing this guide. Grants cover $190,000 of this initial budget. Berkeley estimates that the $25 application fee plus an addition to the interest rate of approximately 1% (included in the 7.75% rate) will cover the ongoing administrative costs of this program.

PALM DESERT

The program is administered through the Office of Energy Management (OEM). About 1.5 full-time equivalents are needed to run the program, and approximately $90,000 from the OEM's annual budget is devoted to the financing program administration. Administration includes energy surveys, solar site checks, advising property owners, processing applications, managing and tracking funds, monitoring energy conservation, and integrating the program with the Set to Save program, Palm Desert's larger energy efficiency initiative. Energy surveys and solar site checks are free and optional consultations done by the OEM to assist property owners in determining how to most effectively participate in the program and how to weigh their energy options.

Residents must receive bids from at least one contractor before applying for funding. The City then orders the title report for verification of owners and liens, and reviews the proposed improvements, contractors' license, and proposed costs of the improvements. After the application is approved and the documentation signed, the work may start. The city records a lien on the property for the amount of the assessment. For large projects that need a partial payment before completion there is a separate contract form and the City checks that the equipment is onsite and secured. After work is completed, the OEM schedules an inspection. After the inspection and approval, the applicant receives the funds needed to pay for the project cost within approximately three weeks.

BOULDER COUNTY

Boulder County does much of its coordination, marketing, and other administration in-house, but it contracts out the financing origination and parts of the application processing to two private entities. Administrative costs are covered by application and processing fees and potentially by interest on the assessment. The application fee is $75, and the processing fee is 1.07% of the total assessment value. Most of this funding will support a program administrator/accountant position in the Finance Division of Boulder County. This person, with support from a third party organization, will be responsible for reviewing all applications; working with the financial advisor to size and sell the bonds; and working with the Assessor's and Treasurer's Offices to ensure that all applicants' properties are included, all liens are filed in time to meet legal deadlines, and certificates of taxes due are prepared and distributed to the appropriate property owners. Once the property owner has acknowledged that work has been completed, the County, through one of the originators, will pay the contractor directly based on the final invoice. This means that the contractor does not receive any upfront deposit or progress payments from the County, but receives the final payment directly as opposed to having funds pass through the property owner.

BABYLON

Babylon expects most of the administrative costs, excluding the salaries of existing staff members that spend part of their time on this project, to be covered by the 3% annual interest rate included in the monthly payments. There are three full-time staff working on processing applications, program administration, and measurement and verification. In addition, the Energy Director of Babylon spends a significant amount of time working on administration, policy, and outreach for the program. Start-up costs included purchase of measurement and verification equipment, including blower door equipment and an infrared camera, at a cost of $10,000.

SAMPLE PROGRAM BUDGET[20]

We provide a hypothetical budget based loosely on existing programs to give a sense of the types and scale of income and expenses that a local government considering this program might expect. The sample budget assumes 800 projects financed in a year with an average project cost of $15,000 for a total of $12 million in funding. These are just estimates, but should give local government leaders who are planning the details of an Energy Financing District a place to start.

The costs are separated into set-up costs, initial expenses that tend to be linked to volume (though some of these categories will see economies of scale, such as marketing), and ongoing costs that are based on volume (these are costs related to the annual processing of payments). The possible sources of cost recovery can vary. Funds can come from 1) application fees, 2) additions to the initial financed amount (essentially a fee tacked on to the project cost), 3) increasing the interest rate, and 4) other sources such as the local government's general fund, grants, and federal stimulus funds. Funds generated from 2 and 3 are basically interchangeable from a financial view point, but having the program costs blended into a set interest rate (as opposed to an additional fee) may be more appealing from the customer's perspective.

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[20] This budget is adapted from projections provided by Renewable Funding, LLC.

SAMPLE PROGRAM BUDGET

PROGRAM ASSUMPTIONS

Average Project Cost Less Rebates	$15,000
Number of Projects	800
TOTAL FUNDING REQUIRED	**$12,000,000**

PROGRAM DESIGN AND PREPARATION FOR LAUNCH

SERVICE		RESPONSIBILITY	AVERAGE COST OR % PER PROJECT IN YEAR 1	ONE-TIME SETUP COSTS	INITIAL FIXED COSTS	INITIAL COST BASED ON VOLUME	ANNUAL FIXED COSTS	ANNUAL COSTS BASED ON VOLUME	TOTAL
A	**Program design & manage local govt approval process**	Local Govt Staff or Partner	$25	$20,000					$20,000
B	**Application processing system setup**	Local Govt Staff or Partner	$13	$10,000					$10,000
ESTIMATED DESIGN AND PREPARATION FOR LAUNCH TOTAL				**$30,000**					**$30,000**

ADMINISTRATION SERVICES

SERVICE		RESPONSIBILITY	AVERAGE COST OR % PER PROJECT IN YEAR 1	ONE-TIME SETUP COSTS	INITIAL FIXED COSTS	INITIAL COST BASED ON VOLUME	ANNUAL FIXED COSTS	ANNUAL COSTS BASED ON VOLUME	TOTAL
A	**Education & Marketing**	Local Govt Staff or Partner	$50				$40,000		$40,000
B	**Customer Service**	Local Govt Staff or Partner	$30		$20,000	$4,000			$24,000
C	**Review Application and Project**	Local Govt Staff or Partner	$100		$20,000	$60,000			$80,000
D	**Printing, Reproduction & Shipping**	Local Govt Staff or Partner	$20			$16,000			$16,000
ESTIMATED ADMINISTRATION TOTAL					**$40,000**	**$80,000**	**$40,000**		**$160,000**

SAMPLE PROGRAM BUDGET (CONTINUED)

FINANCE SERVICES

SERVICE		RESPONSIBILITY	AVERAGE COST OR % PER PROJECT IN YEAR 1	ONE-TIME SETUP COSTS	INITIAL FIXED COSTS	INITIAL COST BASED ON VOLUME	ANNUAL FIXED COSTS	ANNUAL COSTS BASED ON VOLUME	TOTAL
A	**Legal and Financing Expenses:** • Bond Underwriting & Placement • Legal Counsel • Financial Modeling and Payment Schedule • District Formation & Tax Administration	 Bond Underwriter Bond & Disclosure Counsel Financial Advisor Special Tax Administrator	2.13%	$60,000		$180,000		$15,000	$255,000
B	**Lien Recordation**	Local Govt Staff	$75			$60,000			$60,000
C	**Bond Paying and Transfer Agent**	Fiscal Agent	0.21%	$10,000				$15,000	$25,000
D	**Tax Collection**	County Tax Collector	0.25%					$30,000	$30,000
ESTIMATED FINANCE TOTAL				**$70,000**		**$240,000**		**$60,000**	**$370,000**
ESTIMATED ADMINISTRATION, FINANCE, & OTHER TOTAL				**$100,000**	**$40,000**	**$320,000**	**$40,000**	**$60,000**	**$560,000**

SAMPLE PROGRAM BUDGET (CONTINUED)

POSSIBLE SOURCES OF COST RECOVERY

SERVICE		RESPONSIBILITY	AVERAGE COST OR % PER PROJECT	FUNDS ONE-TIME SETUP COSTS	INITIAL FIXED COSTS	FUNDS INITIAL COST BASED ON VOLUME	FUNDS ANNUAL FIXED COSTS	FUNDS ANNUAL COSTS BASED ON VOLUME	TOTAL
A	**Application Fee**	Property Owner	$100 (one time)			$80,000			$80,000
B	**Capitalized Expense** (can be recovered through interest rate or added to financed amt)	Property Owner	$400 (one time)		$40,000	$240,000	$40,000		$320,000
C	**Interest Rate in Excess of Debt Service** (added to base interest rate)	Property Owner	0.5% (annual)					$60,000	$60,000
D	**Local Govt Set Up Costs** (can also be recovered through interest rate)	Local Govt		$100,000					$100,000
ESTIMATED SOURCE TOTAL				**$100,000**	**$40,000**	**$320,000**	**$40,000**	**$60,000**	**$560,000**

9. Defining Eligible Projects & Getting Results

Local governments will need to carefully define what projects are eligible for financing and decide how to verify compliance with the eligibility standards. The basics are set by the enabling legislation; in most cases this limits financing to energy efficiency and renewable energy measures that are "attached" to the property. But there are many details to think through within these broad categories. There are three key questions to address: 1) What are the requirements for participating installers and contractors?, 2) What specific measures are eligible?, and 3) What is the approval process, including any quality assurance? The table below describes how the four cases address these questions.

PROJECT ELIGIBILITY CASE COMPARISON

	REQUIREMENTS FOR PARTICIPATING INSTALLERS AND CONTRACTORS	ELIGIBLE MEASURES	APPROVAL AND QUALITY ASSURANCE PROCESS
BERKELEY, CALIFORNIA	Standard licensing and permitting requirements. Also must be on the list provided by the state-sponsored California Solar Initiative, which has its own set of requirements.	Solar PV (pilot)	The state reviews the solar projects and provides a rebate reservation letter as part of the state solar rebate program. Berkeley's program administrator checks the documentation.
PALM DESERT, CALIFORNIA	Standard licensing and permitting requirements.	Energy efficiency and solar energy projects allowed. Energy efficiency improvements must be more efficient than the minimum required by state efficiency standards for new construction (Title 24).	Program staff reviews the project scope to check for eligibility and reasonable cost. Site inspection of all projects to ensure quality and compliance.
BOULDER COUNTY, COLORADO	Standard licensing and permitting requirements.	Wide range of renewable energy and energy efficiency projects allowed. Specific requirements for each measure included in the eligible measures list (see Section 12).	Program staff reviews the project scope to check for eligibility. Spot checks of some projects to ensure quality and compliance, though many projects already require a building permit and inspection.
BABYLON, NEW YORK	Standard licensing and permitting requirements, plus certification in Building Performance Institute (BPI) standards.	Energy efficiency measures such as air sealing, insulation, caulking, and replacing space heating and hot water systems. The program also finances solar energy if the home already meets ENERGY STAR standards for new homes.	Program staff reviews the project scope to check for eligibility compliance and reasonable cost. Performance testing is required. Also, BPI contractors in New York have third party quality assurance as part of their certification.

GETTING RESULTS

Energy Financing Districts should be designed to get the biggest impact (both financial and environmental) possible from the measures installed. Local governments can provide hands-on support and project guidance, as in the cases of Babylon and Palm Desert, which both provide free audits and advice to property owners. The staff in Babylon particularly tries to make sure that the energy savings are greater than the repayments for the improvements. However, this level of support requires expertise on the part of program staff and funding for staff time. The assurance given to customers will likely lead to a more successful program in the long run, but not all communities have the resources required for this level of service. Local governments that cannot provide this type of service can try to fund this work through programs fees, can look to their local utilities or other partners for support, or can simply have more basic project standards.

Another way to increase quality is to require specific training for the contractors. For example, home performance contractors trained according to Building Performance Institute (BPI) standards are required for energy efficiency financing programs in Vermont and New York. These training programs generally have a third party quality assurance component at least for a contractor's first few retrofits, with spot checks after an initial period. Energy Financing Districts can also use third party verifiers trained by the Residential Energy Services Network[21] (RESNET) to check completed work. Financial benefits to the property owner can be increased by requiring that cost-effective energy efficiency measures be done before installing a more expensive solar PV system. The City of Berkeley, for example, requires that participants installing solar meet the City's time-of-sale Residential Energy Conservation Ordinance requirements for energy and water saving measures. Babylon requires that homes meet the ENERGY STAR performance standard for new homes before installing solar.

MEASURING SUCCESS

Measuring the actual impact of a program will also be important to improving the design over time and justifying its continuation. Program staff should keep a database of statistics with the number of projects, types of projects, and projected energy savings (if available). We also recommend asking participants to sign a utility bill information release form. Both Berkeley and Boulder County do this, which allows them to access the property's utility bill information from before and after the installation to get a sense of the actual energy savings from the project. Surveying the participants to get feedback to improve the program design is also important; Babylon does this on a regular basis and has been able to continuously improve their program as a result.

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[21] Website: http://www.natresnet.org

10. Education & Outreach

There is an enormous opportunity for education through the availability of an Energy Financing District. Information - understanding the benefits of clean energy improvements and how to get the work done - is key barrier to action. Research has shown that larger incentives may increase participation in loan programs, but marketing and implementation may be even more important than the size of the incentive. In one study, program participation varied tenfold between programs offering identical financial incentives. The more successful programs were operated by trusted organizations and marketed by word of mouth and other aggressive, direct methods.[22] Local governments have the opportunity to be this trusted source of information and to work with local partners to engage the community. Many utilities are already engaged in market transformation efforts, so it is vital to check in with the local utility to make sure marketing efforts are complementary where possible.

One interesting model for increasing outreach is Houston's Power to People program. This program offers free weatherization (so no financing is necessary) to low-income residents, but the outreach techniques may be applicable to programs designs that do use financing. The City of Houston targets a neighborhood and sends a letter to every household; this effort results in an approximate sign-up rate of 10% of the residents. Then the city connects with community leaders, the city council member from the community, church groups, neighborhood associations, and others to get the word out. These community groups organize volunteers to do "block walks," where they go door to door, talking to their neighbors about the program. They follow that with a block party featuring food and music to attract more participants. These techniques are relatively inexpensive because they rely on volunteer support, but they have resulted in 40% to 80% participation rates, depending on the neighborhood. If a financing program used these techniques and achieved even a fraction of that - say, just 5% participation - that would constitute a breakthrough in participation rates for financing programs.[23]

Another vital channel for outreach is through contractors and installers. These are the people who will be talking directly with customers on a regular basis. The financing program must fit their needs, and they must understand it well enough to use it effectively as a sales tool. This requires engaging contractors early on, soliciting regular feedback throughout the program development process, and providing workshops to help them understand all aspects of the program.

BERKELEY

Building on the publicity from a voter passed mandate to adopt a climate action plan, the City of Berkeley developed and promoted the pilot program through web sites, focus groups of solar contractors and suppliers, an initial web survey of city residents, an advisory group of influential experts, and workshops for installers and contractors and for the public. The three public workshops consisted of presentations from the City along with Renewable Funding (the processing administrator), and the California Solar Initiative (Pacific Gas and Electric). Well over 300 Berkeley property owners attended the public workshops, and over a dozen solar installers were present to provide information about their services before and after the sessions. Promotional materials for the workshops were distributed at libraries, the City's Permit Service Center, neighborhood associations and to a large database collected over the past year of persons interested in the program. The program also received extensive publicity in the local and national media and interest groups' newsletters. Enough subscriptions to fill all forty available funding slots were made in less than 10 minutes through an on-line enrollment process.

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[22] Stern, Paul C., Elliot Aronson, John M. Darley, Daniel H. Hill, Eric Hirst, Willett Kempton and Thomas J. Wilbanks, "The Effectiveness of Incentives for Residential Energy Conservation," Evaluation Review (April 1985, Volume 10, Number 2).

[23] Fuller 2008 (excerpt).

PALM DESERT

The program is promoted through numerous community meetings, the City's website, articles in the local paper, and the monthly newsletter that the City distributes to the approximately 32,000 households in the City. Many people were aware of the program when it started because there was a lot of publicity surrounding the passage of AB 811. The most effective method of promotion has been through solar and air conditioning installers. The City has quarterly meetings with contractors about the program to update them on the status of the program and to educate them about the application process.

BOULDER COUNTY

Outreach is done through the ClimateSmart Loan Program website, public workshops, contractors, and other methods. Marketing costs are estimated at $20,000 to $30,000 per year. The County entered into a partnership with a local non-profit to provide trainings and workshops. More than 130 contractors have attended County-sponsored briefings about the program, and many are actively promoting the program to their clients. The public workshops guide people through the application process and explain the value of an energy audit, describe eligible measures, and encourage implementation of other measures, such as compact florescent lights (CFLs) and ENERGY STAR appliances that cannot be covered by the program. Attendance at a workshop is mandatory for potential applicants and over 1,700 people attended workshops before the first round of funding.

BABYLON

Babylon has publicized the program to all 65,000 detached homes in Babylon. In August 2008, all residents received a free compact fluorescent light bulb, an energy tips booklet, and an announcement of the Green Homes Program. The cost of this promotional event was covered by a public-private partnership, so there was no out-of-pocket expense for the Town. In February 2009, the Green Homes program was featured on the cover of a recycling calendar sent to each home, and the program has been covered widely by other media such as the New York Times and Newsday. Program staff and city officials also raise awareness of the program by speaking with community groups, schools, and other organizations.

11. Conclusion

With new programs being announced weekly and over ten states pursuing enabling legislation, Energy Financing Districts have the potential to make a significant impact on the adoption of energy efficiency and renewable energy. Local governments must create robust programs that provide valuable financing services while also looking for ways to address other barriers such as lack of information, transaction costs, and the uncertainty of savings. Local government leaders can be major catalysts for change, but they must remember that their potential for impact does not end when the program is launched - success will come through educating both citizens and clean energy providers over time, and by developing community and business partnerships that transform the market for clean energy services.

Scale is the next big challenge for Energy Financing Districts. Cities and counties across the country will need to experiment and share best practices for encouraging participation. These innovations may be effective outreach and education techniques, or they may be ways of pooling risk and assuring savings for individual property owners. Creating financing programs on a town-by-town basis can also be a slow process. It will be important for local government leaders to experiment with new models that speed up the adoption process and allow this type of financing to scale up more quickly. This may be through a countywide approach as in the case of Boulder County, or it may be through statewide support for these programs, or some other yet-to-be-developed mechanism. Additional support can also come from the billions of dollars designated for State Energy Programs, Energy Efficiency and Conservation Block Grants, and Qualified Energy Conservation Bonds through the stimulus package. An Energy Financing District *is* a stimulus program - it creates jobs, saves energy, protects the climate, and invigorates local economies.

12. Resources

The links to all of these resources can be found at: http://rael.berkeley.edu/financing/resources and additional resources from the City of Berkeley can be found at http://cityofberkeley.info\sustainable

STATE ENABLING LEGISLATION

Guidance from Vote Solar / Wilson Sonsini Goodrich and Rosati
A memorandum prepared for the Vote Solar Initiative by Wilson Sonsini Goodrich and Rosati that describes the assessment district authority in various states and amendments to state law necessary to implement Energy Financing Districts. The states reviewed are Arizona, Florida, Hawai'i, Michigan, Nevada, New Jersey, New Mexico, New York, Oregon, Texas, and Washington. The legislation for all states with legal authority for this type of financing can also be found at http://www.dsireusa.org under the policy category called "Property Tax Financing Authorization".

California - Assembly Bill 811

Colorado - House Bill 08-1350

New Mexico - Senate Bill 647

Virginia - Senate Bill 1212

Maryland - House Bill 1567

Vermont - House Bill 446

BERKELEY, CA

Participant Info
This document provides general information for potential participants, including a program overview, participation deadlines, screen shots of the program website, etc.

Program Terms
This document describes the program terms for the participant, including how the program functions, the participant's responsibilities, and clarifications about what the municipalities will not be responsible for (such as the performance of the solar PV system).

Contractor Focus Group Script
Berkeley ran four separate focus groups with solar installers, energy efficiency contractors, solar thermal contractors, and equipment vendors. These sessions were intended to both educate these stakeholders, and also get feedback that could help shape the program. This script was used by Research Into Action, the organization contracted to run the focus groups.

Contractor Focus Group Findings
This document summarizes the findings from the focus groups, which were used to shape the Berkeley FIRSTpilot program. Opinions expressed by the participants include enthusiasm for the basic concept, resistance to requiring energy efficiency measures before other measures, opposition to the city aggregating customers or bulk purchasing equipment and supplies, and some concern about needing to wait until the final approval of the installed measures before receiving payment.

Market Research
Results from a web survey of over 200 Berkeley residents to assess their potential interest in the Berkeley FIRST program.

Approval of Concept for Financing District
The initial request for the City Council to approve the concept of exploring the development of a municipal financing program (November 6, 2007).

Intent to Establish Revenue and Contracts
This resolution approves the acceptance of the grants awarded to Berkeley to fund the program's start up costs (April 22, 2008).

Amendment to Municipal Code to Establish Special Tax Financing Law
This document requests a first reading of the ordinance to amend the Municipal Code to Establish Special Tax Financing Law; includes text of the law (April 22, 2008).

Intent to Establish Financing District and Amend Local Goals and Policies
This document request Council resolutions to (1) set forth the City Council's intention to establish a Sustainable Energy Financing District; (2) set forth the City Council's intention to incur bonded indebtedness; and (3) approve Amended and Restated Local Goals and Policies for Community Facilities Districts and Special Tax Districts (July 22, 2008).

Public Hearing to Establish Financing District
This document includes the Resolution of Formation of the Sustainable Energy Financing District, the Resolution of Necessity to Incur Bonded Indebtedness, the Ordinance Ordering Levy of Special Taxes, the Method of Apportionment description, and a Rate Supplement example (September 16, 2008).

Bond Purchase Contract
This legal document describes how and under what terms the city will issue the bonds and then sell them to the bond purchaser (Renewable Funding).

Fiscal Agent Agreement
The Fiscal Agent Agreement addresses the execution of the bonds and the method of funding for the debt service, administrative fees, and reserve funds.

Closing and Transfer Procedures
The spreadsheet shows the process flow for the actions that are required to issue the bonds and pay debt service.

Special Tax Consultant's Scope of Work
Berkeley contracted with a special tax consultant to provide guidance and also develop the Method of Apportionment and Rate Supplement.

Professional Services Contract with Renewable Funding
This document describes the administrative services provided to the city by Renewable Funding LLC.

Approval of Bond Purchase and Administration Agreements
This document includes the council resolutions to approve the Bond Purchase Agreement and the Administration Agreement with Renewable Funding.

PALM DESERT, CA

Program Talking Points
Concise Q&A about the Palm Desert program and the role of AB 811.

Loan Process
This document reviews the entire loan process for the Palm Desert program, include the loan application criteria and the administrative responsibilities of the city.

Program Report and Administrative Guidelines
Detailed report describing how the program functions, eligibility, requirements, etc.

BOULDER COUNTY, CO

Resolution Establishing the Local Improvement District
Formal resolution to set up the county-wide district.

List of Eligible Measures
Boulder County's list of eligible measures, requirements, and available rebates and tax credits.

Homeowner Workshop Presentation
Boulder County requires all of the participants to attend a public educational workshop. This is the presentation given at that workshop.

BABYLON, NY

Self-Check Home Inventory Form
Babylon starts off the assessment of energy savings potential with this "self-check" form to get key information.

Sample Homeowner Contract
Sample contract between the Town of Babylon and the homeowner.

Sample Contractor Contract
Sample contract between the Town of Babylon and the contractors performing the retrofit work.

Defense of the Program's "Public Purpose"
In response to a local challenge about the "public purpose" being performed by the LIGH financing program, LIGH staff drafted this memo

Appendix

The following excerpt from the proposed American Clean Energy and Security Act of 2009, as passed by the House of Representatives on June 26, 2009, would provide credit support for Energy Financing Districts at the federal level.

TITLE 1, SUBTITLE I

SEC. 188. INDIRECT SUPPORT.

(a) IN GENERAL.—For the purpose of enhancing the availability of private financing for clean energy technology deployment, the Administration may—

(1) provide credit support to portfolios of taxable debt obligations originated by state, local, and private sector entities that enable owners and users of buildings and industrial facilities to—

(A) significantly increase the energy efficiency of such buildings or facilities; or

(B) install systems that individually generate electricity from renewable energy resources and have a capacity of no more than 2 megawatts;

(2) facilitate financing transactions in tax equity markets and long-term purchasing of clean energy by state, local, and non-governmental not-for-profit entities, to the degree and extent that the Administration determines such financing activity is appropriate and consistent with carrying out the purposes described in Section 182 of this Act; and

(3) provide credit support to portfolios of taxable debt obligations originated by state, local, and private sector entities that enable the deployment of energy storage applications for electric drive vehicles, stationary applications, and electricity transmission and distribution.

(b) DEFINITIONS.—For purposes of the section:

(1) CREDIT SUPPORT.—The term "credit support" means—

(A) direct loans, letters of credit, loan guarantees, and insurance products; and

(B) the purchase or commitment to purchase, or the sale or commitment to sell, debt instruments (including subordinated securities).

(2) RENEWABLE ENERGY RESOURCE.—The term "renewable energy resource" shall have the meaning given that term in section 610 of the Public Utility Regulatory Policies Act of 1978 (as added by 2 section 101 of this Act).

(c) TRANSPARENCY.—The Administration shall seek to foster through its credit support activities—

(1) the development and consistent application of standard contractual terms, transparent underwriting standards and consistent measurement and verification protocols, as applicable; and

(2) the creation of performance data that promotes effective underwriting and risk management to support lending markets and stimulate the development of private investment markets.

(d) EXEMPT SECURITIES.—All securities insured or guaranteed by the Administration shall, to the same extent as securities that are direct obligations of or obligations guaranteed as to the principal or interest by the United States, be considered to be exempt securities within the meaning of the laws administered by the Securities and Exchange Commission.